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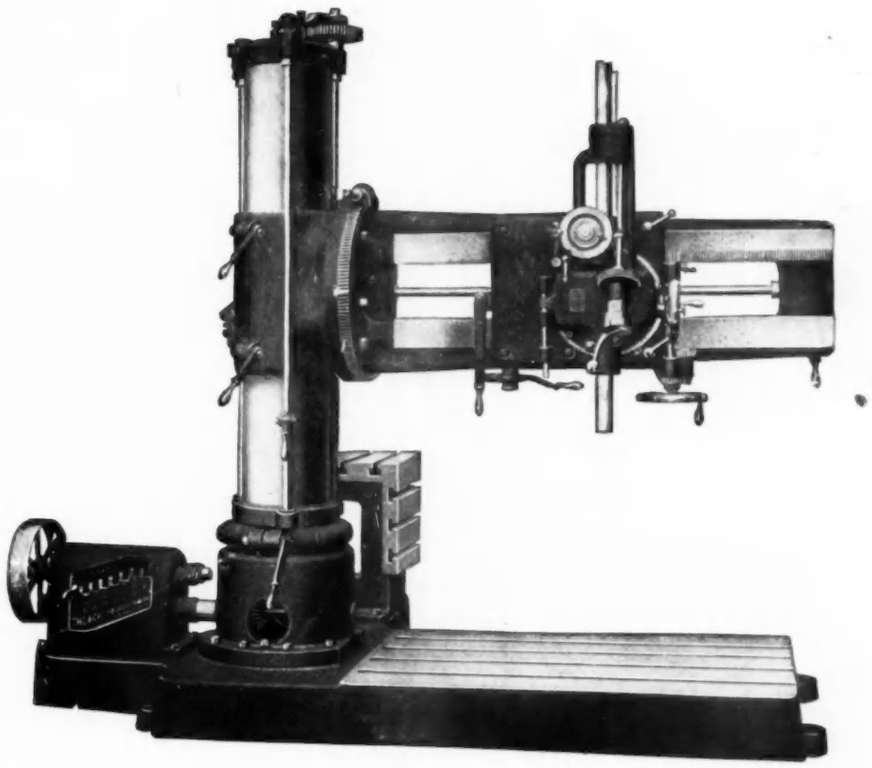

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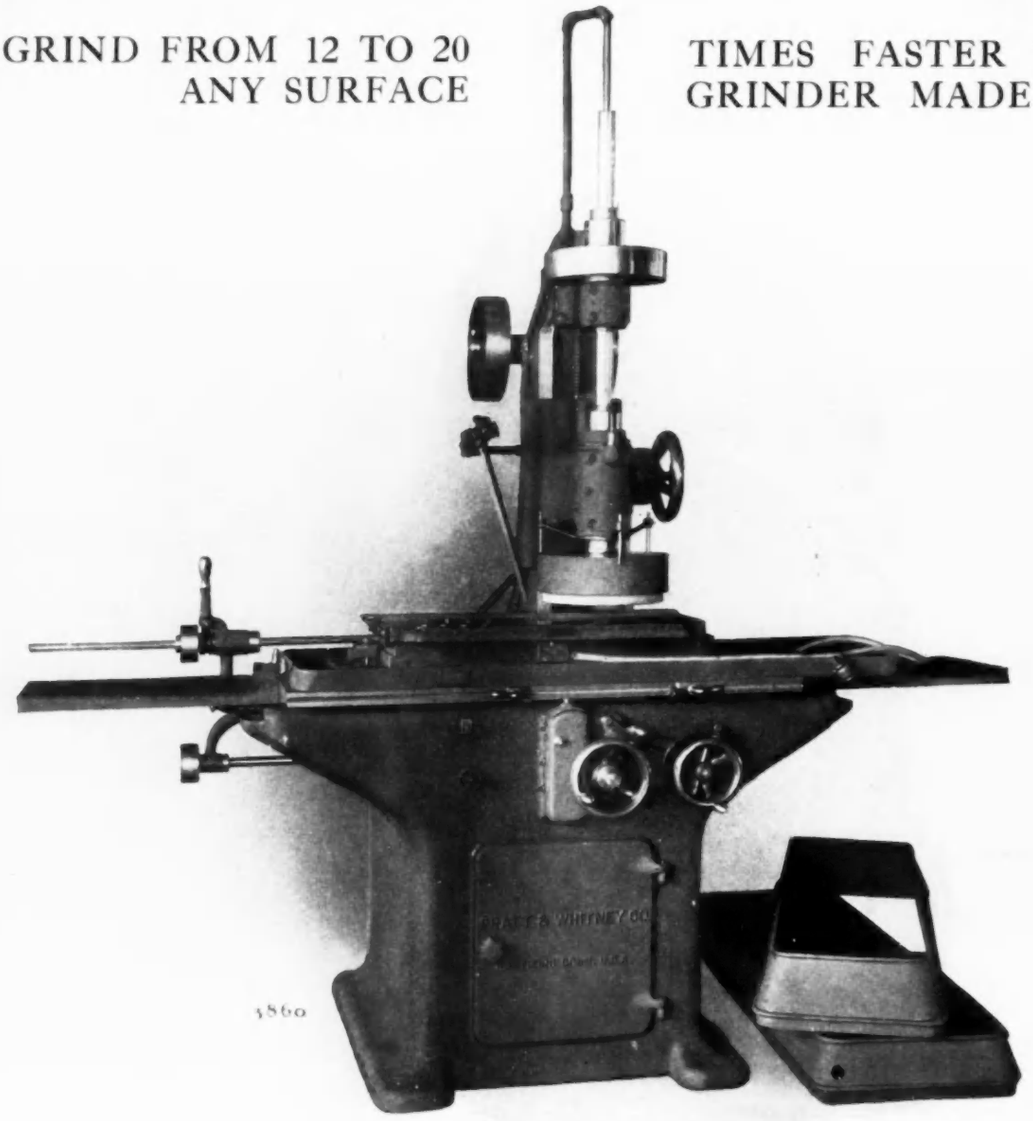

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A New Design for Hardening Rooms

Darkening and Ventilating of Room, Kind, Construction and Fuels of the Furnaces Used by The Standard Tool Company of Cleveland, Ohio

BY E. F. LAKE

The Standard Tool Company, of Cleveland, Ohio, has recently built and put into operation an improved plant, as illustrated in this article, for the purpose of heat-treating the twist drills, taps, reamers, milling cutters and various special tools which it manufactures.

The principles on which this room is designed show a great deal of forethought and study and a thorough knowledge of the requirements necessary to produce conditions under which work can be turned out with absolutely uniform results and those that can be repeated from day to day or from year to year. The human factor has not been ignored in the design of this room, for no matter what appliances may be put on furnaces the intelligent judgment of the operators cannot be ignored. Every detail in the construction has been worked out to aid the operators in their work, not only in making the temperatures easy to judge, but also in taking away the excess heat and foul gases, so that the physical conditions under which the operators work may be pleasant and healthful. This keeps them in good physical and mental condition to do their work properly and also gives the management the satisfaction of knowing that the health and lives of its employees are being looked after.

The general appearance of the room is very pleasant, as one does not see the soot, scale and dirt that is usually found in hardening rooms, to say nothing of that in the faces of the men, and the piles of rubbish do not have to be waded through that are frequently encountered in other hardening rooms, as the floor is as clean as it is possible to keep a cement floor. The absence of heat and foul-smelling gases was also particularly noticeable for, while the temperature outdoors was up in the 80's, on the day of my visit to this plant the interior of the hardening room was cooler than outdoors, and quite comfortable in spite of the fact that some twenty or more of the thirty furnaces were in operation; and while lead baths, salt baths, barium chloride, potash, glycerin, fish oil and other things were being used for the heating and quenching baths, no offensive odors attacked the nostrils even while standing close to the furnaces.

These results are not the effect of spending large sums of money for help to keep the room clean by sweeping and brushing, or putting in expensive apparatus for removing the heat and foul air, but they are the effect of working out the minutest details of construction in such a manner that the natural forces are utilized to the greatest extent and these are then aided by mechanical means to complete the results desired.

In designing this room, Mr. Ryder, the general superintendent, and his assistants kept two things prominently before them. One was to make the operation of the furnaces such that the temperatures at which the work was hardened and tempered could be standardized and uniform results could be obtained for a given class of work even though months elapse between duplicate orders; and the other was to make the conditions under which the men have to work as pleasant as possible.

The latter object has been accomplished in a remarkable degree from the standpoint of one who has been accustomed to seeing hardening rooms in which the smoke and dust were so dense you could scarcely see the opposite side of the room, and the fumes from poor ventilation, or none at all, coupled with the heat made them almost unbearable, or that the accumulations of dirt were such that the lungs were continually filled with dust, thus endangering the health and lives of the operators and thereby making it impossible for them to turn out good work.

While this humane thoughtfulness of the welfare of its employees, which is prevalent in all departments of the Standard Tool Company, might be con-

FIG. 1. GENERAL VIEW OF NEW HARDENING ROOM OF THE STANDARD TOOL COMPANY

sidered as merely philanthropic by some, it was done more in the spirit of justice and, therefore, gives back practical results to the company. For they are able to obtain a more intelligent class of men for their hardening room, and consequently more skill, judgment and ability is shown in the work than would be the

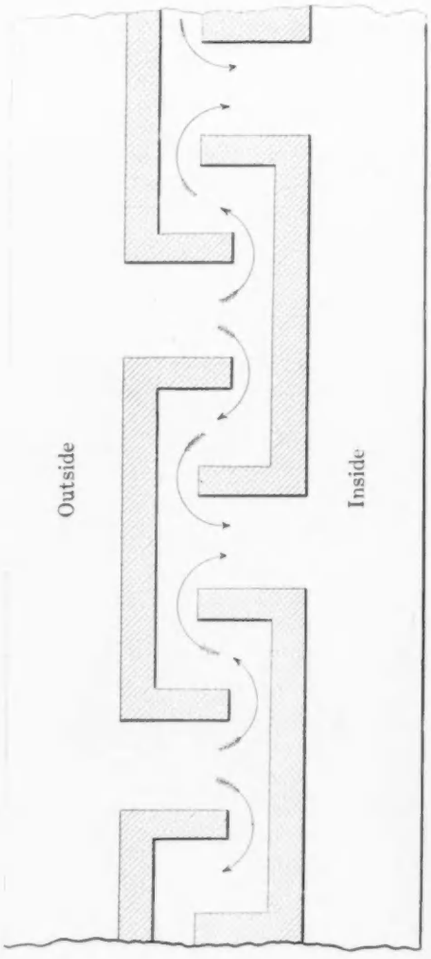


FIG. 2. SECTIONAL VIEW OF WINDOW SHUTTER

case if an undesirable or unhealthy atmosphere was the every-day condition of the room.

Ventilating Arrangement

A general view of the hardening room is shown by Fig. 1. In the center of the room a chamber is built of sheet steel, that incloses the furnaces and their necessary pipes. This is raised a few inches off the floor so that the cool air which comes in through the windows and naturally settles to the floor will pass into the chamber and up through a number of large ventilators in the roof. This insures a continuous circulation of fresh, cool air and aids in carrying the heat of the furnaces away from the operators and up through the roof. These ventilators are located directly above the furnace chamber and between the three stringers running the length of the room, the center one of which acts as a support for the rafters. They are darkened in the same way as the windows, so that light will not penetrate the room and bother the operators in judging colors.

The 22 double windows which are shown on both sides of the room are fitted with iron shutters, opening inside and these are built in such a manner that they baffle all the light, but admit the full volume of fresh air that can pass through the windows when opened to their fullest capacity. A sectional view through the center of these iron shutters is shown by Fig. 2. In this the arrows show the direction of the currents of air from the outside.

This principle was adopted for the purpose of giving the operators a uniform light, throughout the day, in which to judge the color of the steel when heated. The light is virtually the same during the entire day regardless of the conditions of light outside the building.

What light is needed is supplied by incandescent lamps which are inside the long sheet-metal hoods, shown hanging in front of the furnaces. These merely throw a spot of light to the floor and can be moved where they are needed.

Furnaces

The furnaces are located inside the steel partition, 10 feet apart, with a big door in front so the operator can go in and adjust them when necessary. Over each furnace is a hood with a branch pipe running up to the main pipe, as shown in Fig. 3. The main pipe is connected to a fan which sucks the gases and fumes away from the furnaces and blows them into the atmosphere through a chimney which extends above the building.

Both the muffle and radiating type of furnaces are used to heat the metal in. Baths using lead, common salt, metallic salts, potash and other materials are also used. The fuel used for heating in all of these furnaces is natural gas, as a good supply is always obtainable in Cleveland, and the price is such as to make it the cheapest fuel for this purpose. It is also one of the simplest fuels to handle and is very easily controlled. Two gas mains run through the center of the furnace chamber and are connected to each furnace. One of these acts as a reserve for use in case of any sudden call. The pipe lines running through this chamber which

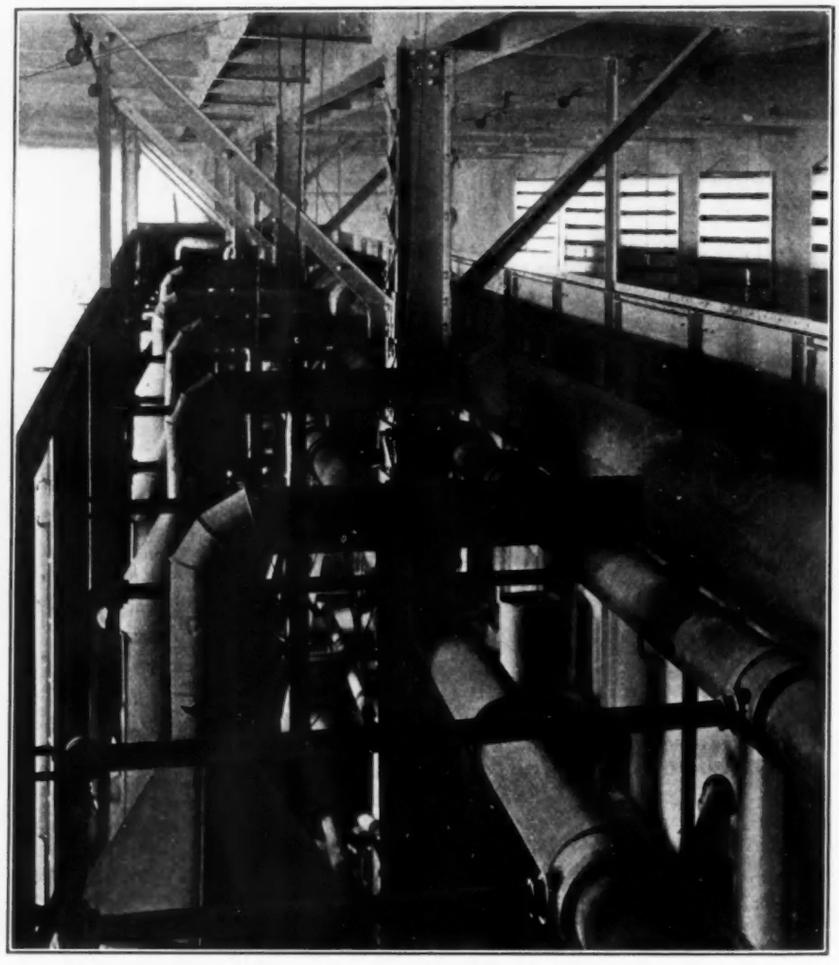


FIG. 3. INTERIOR VIEW OF FURNACE CHAMBER, SHOWING ARRANGEMENT OF PIPES AND FURNACES

deliver gas, air or water to the furnaces and baths and the one taking the heat and bad air away are each painted different colors, with a wide contrast, such as gray, red, green, etc., so that the line can be easily followed in case adjustments or repairs are necessary.

In the large doors in front of the furnace chamber are openings, directly in front of each furnace opening, through which the work is inserted. These openings are provided with two sliding shutters and the shutters are provided with a small square opening so the work can be seen with the minimum amount of heat coming out into the room to affect the operators. These are best shown in Fig. 4.

Another opening provided with shutters is near the bottom of the door through which the fuel gas of the furnace can be lighted.

The only heat, therefore, to which the operators are exposed is that which comes through the small openings regulated by shutters, and, as the furnaces for hardening high-speed steels require a temperature so much higher than the others, an electric fan is placed on a bench in front of them, as shown in Fig. 4, to blow the heat, coming through the shutters, away from the operators.

FIG. 4. IN FRONT OF HIGH-SPEED STEEL FURNACE SHOWING QUENCHING BATHS, ELECTRIC FAN AND TEMPERATURE INDICATOR

CONTROL OF TEMPERATURE

The temperatures of the furnaces are controlled by the operators, but these are not left entirely to their judgment, by colors, as each lot of work is accompanied by a chart which is furnished by the foreman of the department.

This chart gives: First, the correct temperature for the furnace. Second, the length of time that the work should be subjected to this temperature. Third, the materials to be used for the quenching bath. Fourth, the temperature at which the bath should be maintained. Fifth, the furnace or bath in which the hardened tools should be drawn and the temperature of the same. Sixth, the kind of steel and class of work to be hardened; also any other necessary information. The time, date, etc., are filled in by the operator and these charts are filed for future reference and stand as a record by which other work, of a similar nature, can be done at any future time.

A thermo-electric couple is attached to each furnace, which is numbered, and these couples are connected by wire to a clerk's room which is partitioned off by wire screen in one corner of the hardening room.

The apparatus in this room is shown in Fig. 5 and consists of an electric pyrometer shown in the lower part of the center of the cut; a switchboard in front of it and a recording board above it. At stated intervals the clerk connects the pyrometer to the thermo-electric couple, in the furnace, by the switchboard, which is numbered from 1 to 30 to correspond to the numbers on the furnaces. This gives the temperature of the furnace connected up and if it corresponds to the temperature given on the hardener's chart, described above, nothing is done; but if this temperature varies from that 5 degrees or more, the clerk turns the crank under the number on the indicating board that corresponds to the number on the furnace and raises or lowers the pointer to indicate the number of degrees that the temperature is above or below the standard set. Each line on this board represents 5 degrees and the central line is the standard, or what the furnace should register. Thus it will be seen by a glance at the board that the temperature of furnace No. 17 is 10 degrees above the standard set while the temperature of furnace No. 22 is 10 degrees below the standard and furnace 24 is 15 degrees below the standard.

This pointer on the indicator board is connected by wire and pulleys to another indicator at the furnace, one of which is plainly shown to the left of the opening in front of furnace 24, Fig. 4. This, it will be seen, registers 15 degrees below the center line the same as No. 24 on the clerk's combined indicator board in Fig. 5, and as it is directly in front of the

FIG. 5. PYROMETER SWITCHBOARD, PYROMETER AND TEMPERATURE INDICATOR BOARD IN THE CLERK'S ROOM

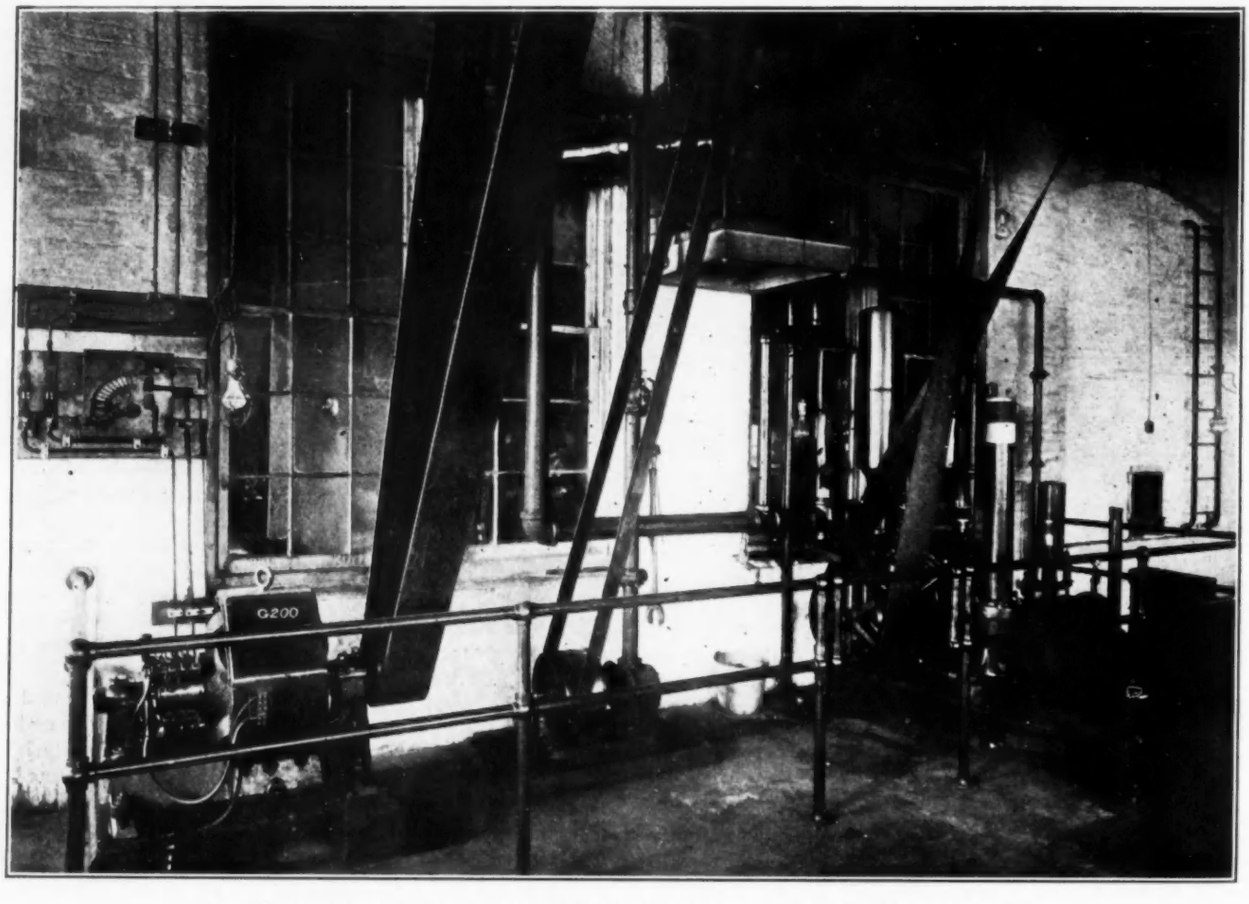


FIG. 6. POWER EQUIPMENT FOR HARDENING ROOM, LOCATION JUST OUTSIDE THE ROOM

furnace operator, he can see at a glance that the temperature of the furnace must be raised 15 degrees.

This system makes one pyrometer do for all the furnaces and serves for a check on the hardener. By having a clerk whose special business it is to look after this, the hardener is not interrupted in his work to get pyrometer readings. The clerk also keeps a record of the actions of the furnace so that the conditions under which a given batch of tools is hardened and tempered can always be looked up.

Quenching Baths

The baths for cooling are located just outside the furnace chamber and close beside the operator, as is shown in Figs. 1 and 4. The same care and skill have been applied to the details in designing these which were used in the rest of the room. Various materials, such as salt water, glycerin, fish oil, condensed steam, which make very soft water, etc., are used for the quenching baths.

The water to supply these baths is pumped through a main pipe, running through the center of the furnace chamber, by a pump located just outside the room, and shown in Fig. 6. From this main it is distributed to the baths. An air pipe also runs to each bath and cool air is pumped into them through a perforated coil in the bottom of each bath. This keeps the baths agitated and the heat generated in them, by quenching the hot metal, is radiated out through the top. This keeps them always cool, and at frequent intervals a thermometer, which is used in each bath, is pulled out and read to see that the desired temperature is being maintained.

In conjunction with this the liquids (other than plain water) composing the baths are given a circulation by placing a tank above the bath and pumping the liquid into this, then allowing it to flow by gravity into the bath. By this method a bath of large volume can be obtained without the use of an unnecessarily large quenching tank to use up the floor space, and a circulation is obtained which aids greatly in maintaining an even temperature in the bath.

The plain water-quenching baths are given their circulation by the ordinary piping system. Many of the quenching baths, such as the oils, are water-jacketed by placing one tank inside of another. The outside tank, in these, is filled with water which is given a circulation, and the inner tank contains the quenching liquid, which is cooled by air blown through a coil in the bottom as described above.

This annealing is done by packing in round cases and inserting them in furnaces using natural gas for the fuel.

The furnaces are built specially for the work and are built in batteries of four furnaces each, one battery only of which is shown in Fig. 7.

The temperature of these furnaces or annealing ovens is controlled by cocks which govern the volume of air or gas used for fuel, and is easily and quickly raised or lowered. A pyrometer is attached to each furnace so that the temperature can be measured accurately. One of these is shown in Fig. 7, fastened to the wall directly over furnace 4 and to the left of the I-beam on top of the furnaces.

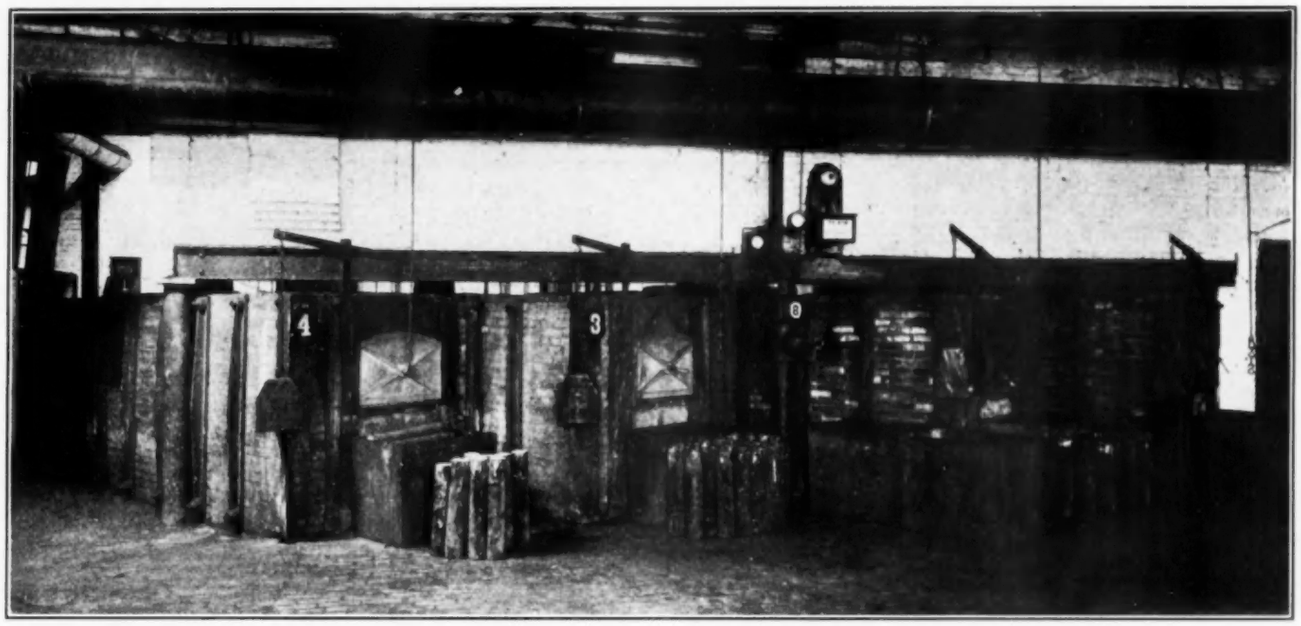


FIG. 7. BATTERY OF FOUR ANNEALING FURNACES WITH PYROMETER ON WELL AT THE LEFT

Power for Hardening Room

The power equipment for the complete apparatus of the hardening room is shown in Fig. 6. This is located just outside of the hardening room and keeps all of the noise, rattle and vibration of the machinery away from the furnace operators, as there are no moving parts inside the room.

The equipment consists of an exhaust-air blower for sucking the heat and bad air away from the furnaces through the hoods which cover them and the pipes, shown in Fig. 3, and delivering it outside the building; an air compressor or pump for giving the air a circulation through the coils in the bottom of the quenching baths; a water pump for giving the necessary water circulation to the various baths and tanks and a dynamo for supplying the room with its power.

Annealing Ovens

The annealing is done in a separate department from the hardening room, and all of the steel used is thoroughly annealed before any work is done on it.

Summary

With all the details of the hardening room worked out with the thoughtfulness, knowledge and skill that is shown in this instance, the Standard Tool Company, of Cleveland, is enabled to secure an intelligent class of men for furnace operators, and this, with the aid which is given them by the mechanical appliances, enables the company to harden and temper thousands of pieces daily in a manner which reduces the variation between two pieces, to a point that is almost imperceptible. Months of time may also elapse between the hardening and tempering of different batches of work and yet practically no variation will be shown in the hardness, and therefore the cutting properties of any two tools of the same class will be uniform, for such tools as the drills, taps, reamers, milling cutters, and special tools, which the company manufactures. Likewise it is a simple matter for them to produce tools of the highest efficiency obtainable.

Grinding Machine Troubles and Their Causes

The Instructing Demonstrator Understands Grinder Difficulties and Can Be Profitably Employed in Missionary Work among the Uninitiated

BY A. B. SCHLEIFER*

Mr. Heald, in his article at page 560, gives vent to some grumbling that is to a certain extent excusable; but is not most of his trouble due to the modern grinding machine and its auxiliaries being too little known? You may go into many well known shops at the present day and find that grinding operations are practically unknown except in their crudest form, but with other machine tools, even if of a special nature, there is not the same difficulty because their primary principles are pretty generally understood.

The Instructing Operator

The decision of Mr. Heald to send out an instructing operator with all future machines is to be commended, and in some cases will be a means of saving him further trouble and expense, but will by no means fill the bill. He speaks of his demonstrators teaching the operator "and to some extent the foreman and superintendent" the use of his machines and appurtenances. If the foreman and superintendent will only absorb the information given, some real and lasting benefit may result to him and his customers and the trade generally. Being as yet something of a specialty a grinding machine requires that a specialist shall attend to give it a send-off, that is, assuming that its maximum output is desired. This is the case in Europe, and I am almost tempted to say that I am glad to hear that it is very much the same in America, Mr. Editor, as we often have your people quoted to our disadvantage, probably as a means of taking the starch out of us.

The Demonstrator's Duties

It is a very rare case where a grinding machine continues to run to its full advantage after the demonstrator has left it and Mr. Heald's article has influenced me to relate what I know are some of the reasons. The duties of an instructing demonstrator, as I understand them, are, first, to give a practical demonstration of what his machine is capable of; next and more important, to instruct the future operator and bring his output up to as near the maximum as possible. In many cases his mission seems to be entirely misunderstood by the firms he waits on, more especially if they are paying some fixed sum for his services. There would seem to be a frantic desire to get value for money in a temporary maximum output, or in other words, they use him entirely as a manufacturer, completely ignoring the fact that little is being learned by merely watching him operate. Probably in his last hour's stay he is asked to let their man handle the machine and finds to his disgust that he is totally unsuitable or lacking in interest. In other cases his time and efforts are made abortive through the apathy of the foreman or superintendent who is satisfied to leave the chosen future operator of the machine the whole business of handling it. The not unusual consequence is that the man leaves some short time afterward, taking his monopoly of knowledge with him and the trouble begins.

The Responsibility of the Foreman

Of course, the foreman is not always to blame for this, for his other duties may be too numerous to allow of special and prolonged attention, but in many cases he feels his elevated position too much to take more than a superficial interest in actual practice and, of course, the knowledge he obtains is of relative value. There are some rare and pleasant exceptions to this; these are when the foreman is not too superior to don a smock and take both a hand at the machine and copious notes of what is not so much in evidence at the time. The sojourn at the factory then becomes a pleasure to the demonstrator because he is almost assured that the machine will be a permanent success and do credit to himself and the time he spent there.

Until grinding practice becomes more general and competent labor as plentiful as that for other processes of machining, demonstrators will be necessary, and it is apparent that their duties do not end with the installing of machines. Owing to the constant lapses on the part of users of machines and in some measure revised methods and materials for increasing output, the demonstrator has a certain amount of missionary work to perform which is undoubtedly to his employer's interest, and being thus a necessity he is part of the grinding-machine makers' organization. When, however, his services are requested in cases like those stated by Mr. Heald, it is only reasonable that those who summon him should bear the expense and often it is money well invested.

The Expert's Experience

Even where grinding is an old established practice there is rarely anything lost by asking for the services of a demonstrator occasionally, and sometimes there is a tangible gain. It generally happens that he can give some points from his varied experience that are of lasting value. If, on the other hand, it is found that nothing of value can be obtained from him, he may be released before much expense has been incurred.

For example, complaint was made that a surface grinder was doing poor work, and that the surfaces ground were showing the pitch of the table-rack pinion and a series of fine chatter marks. A man was sent who investigated and found that the table ways were rarely lubricated and were all gummed up, also that they were using a wheel too fine and hard. The table was well cleaned and oiled, and a soft, coarse wheel substituted, after which the machine ground properly and the output more than doubled. Two other machines were near at hand with similarly unsuitable wheels, and the same change was made with the same profitable results. Many similar instances could be related where profitable results have followed the chance visit of an expert demonstrator, and if a charge had been made for expenses it would have been a good investment.

Trivial Troubles

Some of the trivial troubles that have involved the calling for help in connection with grinding machines may be worth relating, and the little things that cured them may perhaps be instructive in some cases. It was reported of a plain, cylindrical machine that almost all the work from it was marred by fine chatter lines, and the request was made that a man be sent at once. A demonstrator was despatched who, after overhauling the machine, proceeded to grind and got good work without any trouble, although using the same appliances. As the difference seemed mysterious the operator was told to get to work and the cause of the chatter was at once made apparent. The tailstock spindle of the machine was provided with a spring to compensate for expansion and contraction of work, and the operator, being an old lathe hand, was in the habit of clamping the spindle when he placed the work between the centers; the somewhat heavy preliminary cuts warmed and elongated the work and in the lighter finishing cut it became cool and, therefore, loose on the centers. This was the cause of the chatter, and it meant a journey of 400 miles to straighten it out.

Other Reasons for Chatter Marks

Other cases of chatter have been caused by the operators not recognizing the value

*Of London, England.

of steady rests and sometimes by their laziness in not fixing them. In very many cases reported the trouble has been found to be due to the variable speed of the machine when driving from a main shaft which was overloaded. In one instance the wheel varied in speed from 750 to 1400 revolutions per minute every few seconds. No grinding wheel can be said to be a permanent truly balanced body, and truing it up at one speed and grinding at a different one is almost certain to cause chatter. The remedy in these cases has been to move the machine to another and more favorable locality, or to provide a separate motor drive.

A Lack of Water

Complaint was made that a large cylindrical grinding machine would no longer grind round work; that some 6-inch piston-rods finished in the machine were as much as 0.002 inch and 0.003 inch oval; could any suggestion be offered as to the cause? A reply was sent telling them to look to the centers and to use a full supply of water. Next came a letter saying all this had been attended to without any better result and they would be glad if a man could be sent at once. The demonstrator on arriving at the works found the water cock turned on full, but the rubber connecting pipe clogged up with filth; there was in fact about a gallon of water per minute being delivered instead of 40 or 50 gallons, and as it was not sufficient to maintain uniform work temperature, the work kept changing its axis, thus causing the wheel to grind on one side only and also causing a whip in the rod. After the water pipe was cleaned the machine ground satisfactorily. This is only one of numerous instances of similar character. Others have been apparently due to some fear of the water making a mess, but in all cases it has been at once assumed that there was something mysteriously wrong with the machine and apparently little time employed in investigation.

Steady-rest Troubles

We have had cases of unround work to investigate, involving long and expensive journeys which were due to slovenly centering; others have been due to improper setting of steady rests or an attempt to make one size steady shoe do for three or four different diameters of work.

These have generally been on work of a long character when the center points are not responsible for the contour of the whole length. Flexible round pieces, of course, must depend on the steady rests for their cylindrical form at some distance from the ends, and if the point directly on the center line be unsupported, it is likely to grind out of round.

Other Sources of Annoyance

Among the minor troubles may be included the sometimes small and meager center holes in cylindrical work or center boring with no regard to the proper angle and absence of pin drilling; the clumsy belting on some machines with their extra thick joints or mail-clad fastening which cause so much shock and jar as to make nice work almost impossible, and the general ignoring of the machinemakers' instruction for setting or erecting machines. All the troubles here enumerated are foreseen and provided for in a booklet compiled and sent out with each machine, yet this does not seem sufficient.

As to who should bear the cost of the sometimes expensive visits it will always be difficult to determine. It would seem just and fair to assume that where the machine is at fault, and within a reasonable time of its delivery, the maker should be responsible, but when the trouble is a result of stupidity or of not adhering to instructions provided, then the user should certainly pay; but a Solomon would be required to arbitrate in many cases. The majority of grinding troubles are undoubtedly due to the limited knowledge of the properties of grinding wheels and the machinemaker at times unconsciously suffers from this if not constantly alert.

Unsuitable Wheels

A machine was put down some time ago for the grinding of small axles and gave every satisfaction. Some 12 months afterward a representative of the maker called at the factory and was told that they had discontinued using the machine owing to the high cost for grinding wheels. Some further inquiries showed that after the wheel supplied with the machine had worn down another had been procured from a local agent, which was too soft. Complaints were made to the agent of its rapid wear and he advised a slower speed which increased the wear so the whole thing was given up in disgust. It should also be said that the works foreman was hostile to the machine, he being somewhat of an old fogy. Finally a wheel was supplied by the grinding-machine maker which was suitable and which resulted in a saving of some 60 per cent. in their method of machining the axles. This is no doubt an exceptional case, but is not so in its broader sense for many people almost abandon their grinding operations or very much limit them from somewhat similar reasons. Both the grinding machine and the wheelmaker are compelled for these reasons to worry their customers for their own good to see that they do not lapse, and must continue to do so until grinding machines are as common as other tools.

A "Spluttering" Wheel

Some experiences of a demonstrator have at times their humorous side as may be expected. We sent a man some time ago to call on a firm to whom a cylindrical machine had been supplied some weeks previously in an out-of-the-way district. On calling at the works he was told they were doing very well and were quite satisfied and also asked him to see the machine as their operator might have some questions to ask. On reaching the machine the said operator was seen to be struggling with a 2½-inch by 4-foot shaft with the object of getting it between the centers. Our man proffered some help, at the same time asking him how he liked the machine. "Oh," said he, "it's all right, but I think the stone is too soft, for it always 'splutters' when I start at the end and it won't last." Our man could hardly grasp what he meant, and decided to watch him working. He first fed the wheel in its full breadth on the end of the shaft, sizing carefully with a pair of spring calipers which he had set to a gage; and when down to size he threw the clutch lever in with the evident intention of moving all the stock at one chip. As there was some 0.040 inch for removal, it can be imagined what he meant by "splutters" and a too soft wheel.

Russian Tallow as a Lubricant

Another amusing experience was enjoyed by the same man at a factory where he went to inquire into a wheel-spindle bearing heating up. Just before leaving at night the operator of the machine complained that the machine table went very hard, and it was found that the oil wells in the base were almost empty. Our man told him to fill them up, with a thick quality of oil preferably, and came away. The next morning the operator complained that the table went no easier, although he had done as requested and an examination of the oil wells showed them to be full of congealed tallow. It seems the operator had been unable to find any other than the ordinary machine oil which was rather thin, and he had conceived the brilliant idea of melting and mixing two parts of russian tallow to one of machine oil.

Too Close Fits

Just another experience to show that the bogey of grinding grit adhering to ground work is not yet laid. A firm making a line of textile machinery put in a cylindrical machine and were at once pleased with the superiority of the work over what they had previously done. A short time afterward they wrote complaining that they had several revolving parts get fast in the machines that they were building, and that this had rarely occurred when they finished them with the file and emery cloth. Did we think that the wheel grit got embedded in the work? As the factory was close at hand an official was sent to inquire into the matter and found the whole trouble was due to their making too close fits. The foreman explained that they had tried to work as closely previous to having the grinding machine, but the cost of production was too great; the case with which the accu-

rate sizing could be obtained in the new grinder had been too much to resist, and they had gone to the other extreme.

It was explained to them that these parts must have sufficient play for lubrication, and also that some tolerance allowed in the grinding would materially increase the output of the machine, and the advice was acted on with satisfactory results; at the present time these people have three grinding machines running and have just recently started a limit-gage system throughout their factory.

Steering Clutch for Automobiles

By H. D. Chapman

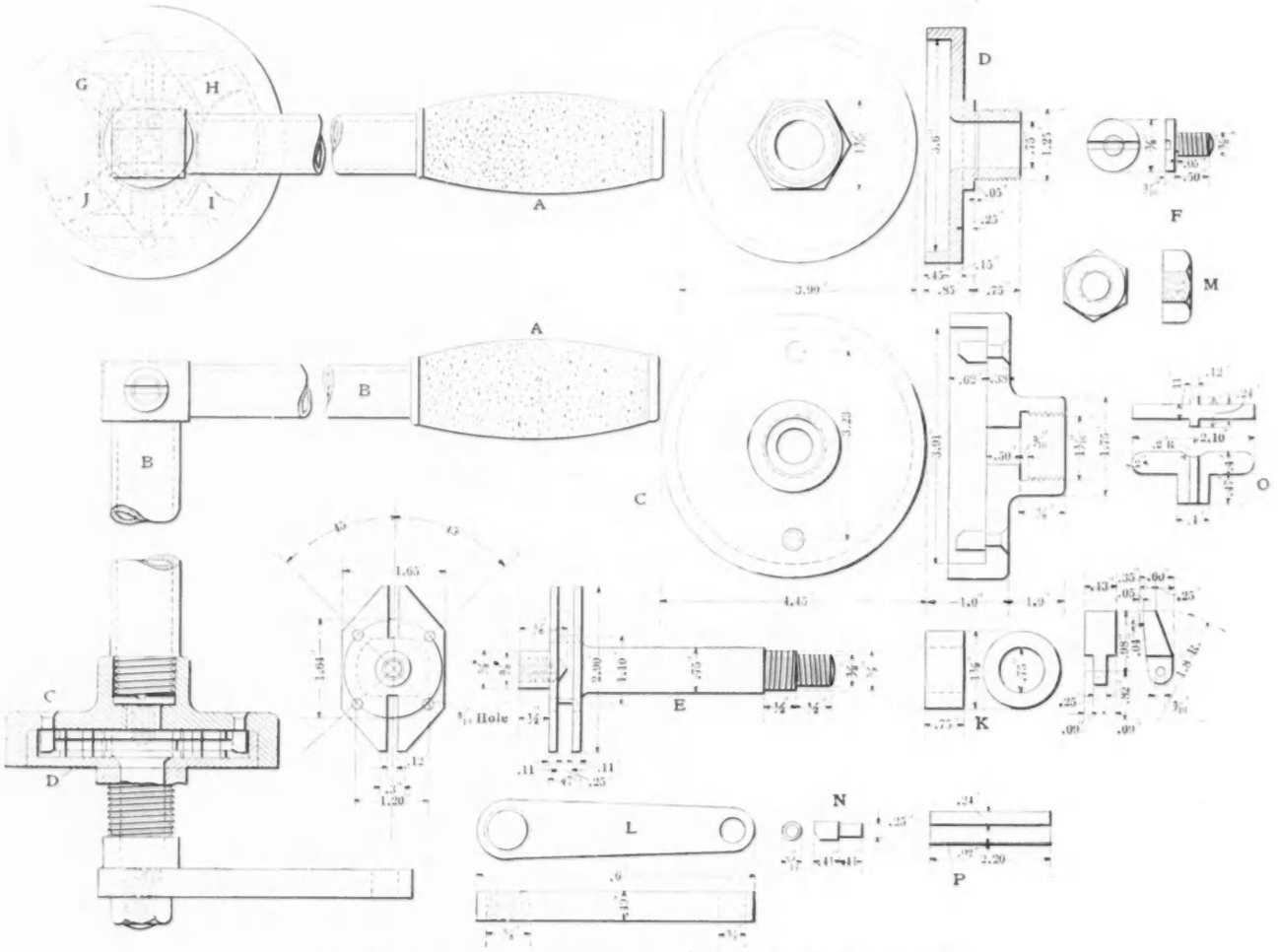
The line cut shows a friction-steering clutch for assuring more safety in steering automobiles. In cases where the automobile is steered direct, it is dangerous because the front wheel may strike a stone or rut and shift the wheels, which is very likely to throw the steering handle out of the operator's control. In cases where steering is done with a worm engaged in a worm wheel, it often requires one or more turns of the steering wheel to make a short turn on the wheels, and this is very objectionable.

This friction-steering clutch was designed for the purpose of steering an automobile with the least amount of movement in the steering wheel or lever, the steering being direct. The clutch is rigid and will not move except when the operator works the lever and with it a person may ride along with his hands off the steering handle without danger of the front wheels shifting.

The operator's handle *A* is attached to steering rod *B*, which is screwed in release wheel *C*. The friction cup *D* is secured to the body of the automobile. Pawl-carrier shaft *E* fits in friction cup *D*, and is attached to release wheel *C* by screw *F* so as to allow free motion of the release wheel *C*. The four pawls *G H I J* are so fitted that the two opposite pawls work in the same direction, the remaining two working in the opposite direction. A collar *K* is pinned on shaft *E* to prevent up and down motion on the end of the shaft. A right- and left-hand thread is cut on the end of this shaft so that the connecting rod *L*, which connects to the axle, screws on shaft *E* left-handed and nut *M* right-handed, thus causing it to act as a lock nut.

When any strain is caused by the tendency of the front wheels to shift, the pawls hold by friction against the inside of the periphery of friction cup *D*; pawls *G* and *H* holding in one direction and pawls *I* and *J* in the other, depending on which way the strain may be. When the operator moves handle *A*, either to the right or left, the release pins *N* press against the release bars *O*, which in turn causes the pawls to release their hold on the friction cup. When the pressure is removed from the operating handle the steering clutch takes a neutral position, by two springs *P* forcing the pawls back against the inside of the periphery of the friction cup, but any strain either way will cause them to take a firmer hold on the friction cups.

This steering clutch is the invention of H. D. Chapman, 103 Seaton place, N. W., Washington, D. C.



ASSEMBLE AND DETAILS OF FRICTION-STEERING CLUTCH FOR AUTOMOBILES

The number of Swedish towns which contract with the various electric-power stations, most of which are located at large waterfalls, is constantly increasing. The Hemsjö station supplies Kristianstad, Sölvesborg, and Karlshaum; the latter town is about 45 miles distant from the station at Upper Hemsjö, and has just contracted for the supply of the town's full requirements for electricity.

The Construction of Graphical Charts

Alinement Charts with Double Scales and Two Pairs of Axes—The Hexagonal Index Chart and a Modification of It and Alinement Chart

BY JOHN B. PEDDLE*

In a previous article I outlined the methods used in constructing the alinement form of chart for the solution of engineering formulas. The present article is intended to supplement the information given there, and to elaborate certain suggestions which were made as to the possibility of increasing the scope and usefulness of these charts by comparatively simple modifications of the primitive type. In order to avoid covering the same ground twice a knowledge of the elementary demonstrations given in the first article is presupposed; they will not be repeated here.

When a chart is intended to cover a considerable range of values we are confronted with the difficulty that it must be large, and therefore awkward to handle, or we must have scale divisions which are too small for accurate reading. These difficulties may be overcome with but little additional trouble by a system of double graduation of the axes.

In Fig. 1 let A and C be the outside axes of an alinement chart, and B the support on which the results are to be read. Say we wish to graduate the A-axis for a length equal to a-c, and that this length is too great for our chart if we use a desirable scale unit. Take a length a-b, equal to about half of a-c and lay this off on the left-hand side of A and graduate it. On the right-hand side of A lay off the rest of the length, or b-c. Call the first scale I and the second II. On the C-axis do the same, graduating the first half of the desired length, (which we will call d-e) up the left-hand side of the axis, and the second half, or e-f, on the other side. Mark them I and II to correspond with A. The location of the central support and its scale unit, or modulus, is determined as previously explained for the simple alinement chart. The left-hand side will be graduated with values, say from g to h, corresponding to I and I on A and C, and marked I, while the right-hand side will be graduated from h to i, corresponding to II and II on A and C, and marked II.

So long as we wish to get values on B corresponding to I and I, or to II and II on the A- and C-axes we evidently have no trouble, but if we attempt to combine I on A with II on C we find no place on B where the result can be read. We are, therefore, compelled to use two new axes, one for values of B and the other for C. Call these new axes B' and C'. On C' graduate the left-hand side exactly the same as the right-hand side of C, or from e to f, and the other side like the opposite side of C, or from d to e. Mark these scales III and IV respectively, and since the III side of C' is to be combined with the a-b length on A the latter had better also be marked III. For the same reason mark the right-hand side of A, IV.

The central axis, B', must be located in the same relation to A and C' as was B to A and C, and will be graduated on the left to correspond with the combination III-III on A and C', and on the other side to correspond with the combination IV-IV on the same axes.

At first sight this diagram is a little confusing and there is always a chance for mistakes in connecting up wrong pairs of

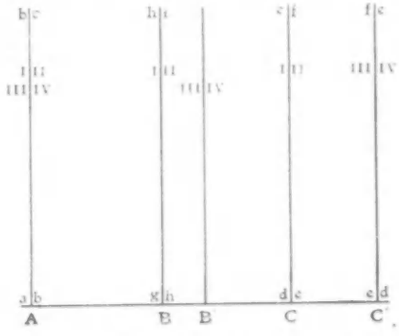


FIG. 1. DIAGRAM OF AN ALINEMENT CHART WITH TWO PAIRS OF AXES

axes. If a little care is taken, however, to see that the readings are made on axes bearing the same Roman numeral, the seeming confusion will disappear and the liability to error will be small.

The process of constructing this chart is so simple that further explanation seems unnecessary. For purposes of illustration the area chart shown in Fig. 12 of the former article, see page 753, Vol. 31, Part 1, is reproduced in Fig. 2 by this method. A comparison with Fig. 12 will show that while the new chart is somewhat more complex in appearance it permits the use of divisions which are so much larger that they compensate in a large measure for the additional confusion.

An Alinement Chart Solving Four Variables

So far the alinement charts as described have only taken account of three variables. This is not a necessary limitation and we will next consider a case in which the number of variables is four. For illustration we will use the formula for the load supported by a helical compression spring

$$P = 0.196 \frac{d^3}{r} f,$$

where P is the load, d the diameter of the wire, r the mean radius of the coil and f the fiber stress. Say we wish to have our chart cover wire from No. 10 to No. 0000 B. & S. gage, or from 0.102 to 0.46 inch diameter. Let us assume that the mean radius of the smallest spring will be ½ inch and of the largest 2 inches, and that f may vary between 30,000 and 80,000 pounds. Put the equation into its logarithmic form

$$log.\ P = log.\ 0.196 + 3 log.\ d + log.\ f - log.\ r.$$

We will have to make two steps in getting our solution, and in each step but three variables must appear. Therefore let us say

$$log.\ 0.196 + 3\ log.\ d - log.\ r = log.\ q$$

and

$$log.\ P = log.\ q + log.\ f.$$

These two equations are evidently of the same form as those previously treated by the alinement chart, and will be charted by exactly the same methods. The quantities d and r, or rather their logarithms, we will plot on the outside axes and read q on the support. See Fig. 3. Since $log.\ d$ and $log.\ r$ are affected by opposite signs the positive values of these quantities will be laid off in opposite directions from the base line. As previously explained the base line may be made sloping, and for convenience we will suppose that this has been done here. Our former constructions depended upon a knowledge of the position of this line, but once the matter is understood there is no real necessity for actually locating it, and in the present instance it will be disregarded.

We have assumed that the values of r are to lie between 0.5 inch and 2 inches. The logarithm of 0.5 is —0.301 and of 2 is +0.301, making a total range of 0.602. Choosing a suitable scale unit, this length is laid off on a vertical line at the right of the paper. The middle point will evidently be lettered 1, and will be the point at which this axis is intersected by the base line, a matter of no importance, however, in the present instance. If we call directions upward positive and downward negative, and remember that $log.\ r$ has a minus sign we will see that the point cor-

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responding to 2 will be at the lower end of the line and that corresponding to 0.5 at the upper end. Graduate the intermediate portions for as many values as are desired, of course, in their logarithms. The other outside axis, on which d is to be laid off, is drawn to the left of the axis just constructed, and may be placed in any convenient position. The values of d called for lie between 0.102 and 0.46 inch for which the logarithms are 1.0086 (or —0.9914) and 1.6628 (or —0.3372). *Log.* d is to be multiplied by 3 however, and therefore these values become —2.9742 and —1.0116. Their difference is 1.9626 which, after multiplication with the scale unit, gives the graduated length of the d-axis. If we use a scale unit of ⅓ the size of that used on the r-line we will get substantially the same length for the two axes. It will be convenient, in graduating this line, to take the r-line unit and graduate the logarithms of d directly from it rather than use the ⅓ scale and then multiply by three.

The position of the zero on this line (corresponding to 1) will evidently be beyond the upper end, since all the logarithmic values are negative. The point marked 0.46, being nearer 1 than 0.102, will be at the upper end and the other at the lower. Having chosen the positions for the limits of this line we proceed to graduate it.

The logarithm of 0.102 is 1.0086. Lay your engineer's scale on the line so that the point chosen to represent 0.102 is opposite 0.86 on the scale. Then with the aid of a table of logarithms pick off the intermediate points up to 66.28. Our formula shows that *log.* 0.196 should be added to 3 *log.* d. The method of making this addition was explained in the previous problems where we worked from the base line. In the present case where we are ignoring the exact position of the base line we disregard the *log.* 0.196 since its only effect is to change the distance of our indefinite base line from what we must look upon as the fixed position of the d-line graduations.

While speaking of the d-line I should like to call attention to the remarkably regular appearance of the graduations. The nearly equal spacing means that the diameters of the wire increase by approximately a geometrical progression.

We must next locate the position of the r-d support and determine the value of its scale unit. The scale units on the r- and d-lines are in the ratio of 1 to ⅓. If we take the unit for r as the standard of reference, we find from equation (10) of the former article that the unit for the support will be

$$\frac{1 \times \frac{1}{3}}{1 + \frac{1}{3}} = \frac{1}{4},$$

and from the same ratio of units on the outside axes we find that the support should divide the distance between them in the proportion of ¼ to ¾. (Equation 9.) The support may now be drawn and might be graduated in the unit we have determined if there were any need to have the numerical result of the r-d operation. As this will not usually be wanted we will save ourselves the trouble.

Take now the second of the equations started with,

$$log.\ P = log.\ q + log.\ f$$

which shows that P is the product of the multiplication of q and f. Their scales will be the outside axes and P will be graduated on the support between them. We have assumed a variation of f from 30,000 to 80,000. The logarithm of 30,000 is 4.4771 and of 80,000 is 4.9031. The difference, 0.4260, multiplied by the scale unit chosen, gives the length of the axis. In the chart made for this article the scale unit selected for the f-axis is ½ that of the reference standard used on r. It would have been better on some accounts if the unit had been made larger in order to get greater scaled lengths on the different axes. I found, however, that any larger scale unit that I could use would give a unit for graduating the P-axis which would be utterly impracticable with the ordinary engineer's scale. The graduation of the P-scale might, of course, be made by a series of projections from the other axes had there been any pressing need to have the f-scale long, but this is a tedious operation. In the problem we are considering the values of f will generally be expressed in round numbers, and there will be no need of minute subdivision—the chief advantage of a long scale. Accordingly the unit value of ½ was chosen for f.

In locating the f-line it was simply placed as far to the right as it would conveniently go without interfering with the r-line, and, as with the other axes, the graduations are located on it in any position we please. Beginning at the lower end, which we mark 30,000, we graduate up with the logarithms of the desired fiber stresses until we reach 80,000.

Lastly we must locate and graduate the

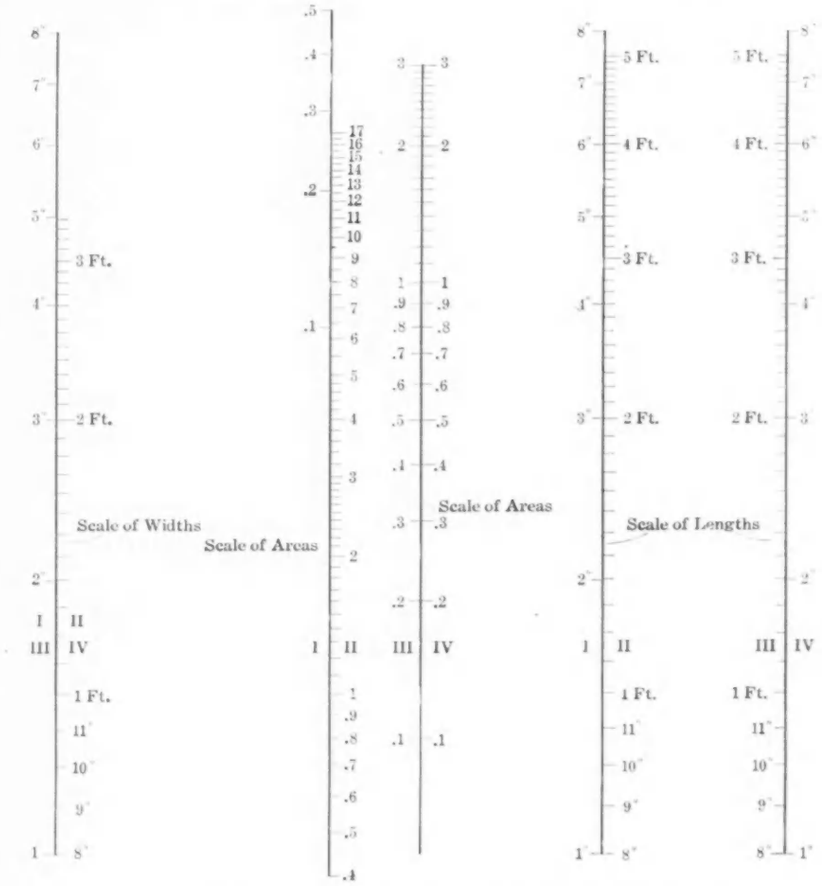


FIG. 2. AN ALINEMENT AREA CHART WITH TWO PAIRS OF AXES

P-axis. The scale unit for the r-d support has been found to be ¼. That of the f-line is ½. Therefore, substituting in formula (10) we get for the scale unit for P

$$\frac{\frac{1}{2} \times \frac{1}{4}}{\frac{1}{2} + \frac{1}{4}} = \frac{\frac{1}{8}}{\frac{3}{4}} = \frac{1}{6}.$$

The P-axis will divide the distance between the f- and q-lines into parts which have a ratio of 2/3 to 1/3. The range over which we must suppose the values of P to vary is a trifle indefinite. It will not do to substitute the values of the variables already settled upon, which give the minimum and maximum values of P for this would lead to absurd combinations. It is not likely, for instance, that

a spring would be made of No. 10 wire and a 2-inch coil radius, and it is still less likely that wire 0.46 inch in diameter would be used in a spring whose coil radius was ½ inch. Taking average conditions I find that the range for P should be somewhere in the neighborhood of from 10 to 1000 pounds. To make sure of being on the safe side I have extended

$$P = 0.196 \frac{0.102^3}{1} 50{,}000 = 10.4.$$

On the chart join up $d = 0.102$ with $r = 1$ and find the intersection with the r-d support. From this point draw a line to 50,000 on the f-line and find its intersection with the line chosen for P. This must be the point corresponding to 10.4, whose logarithm is 1.017. We have thus

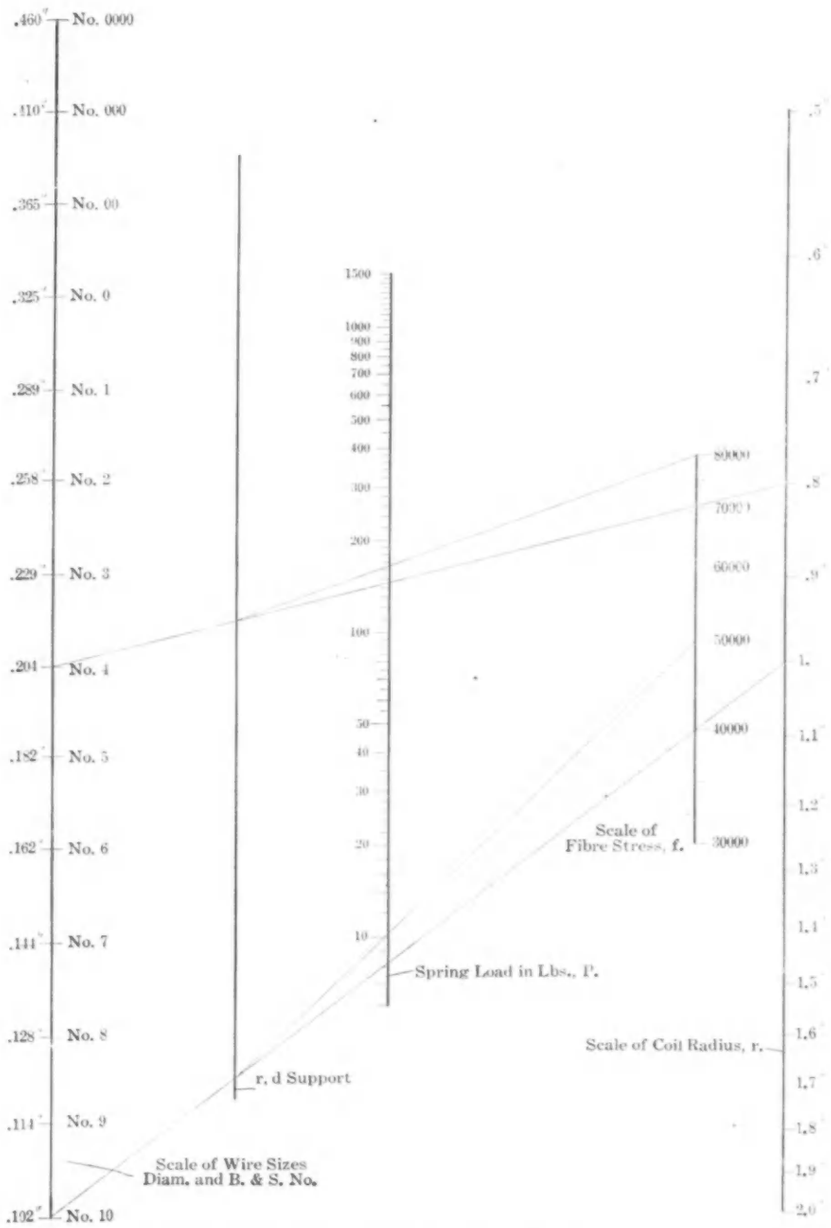


FIG. 3. ALINEMENT CHART FOR DETERMINING LOAD SUPPORTED BY A HELICAL SPRING

the limits a little beyond each of these values.

Now when it comes to starting the graduations on P we ought, properly speaking, to know the location of the base line; but we have completely lost track of this, and it cannot, therefore, serve us. We may easily locate one point on P, however, if we run through a trial calculation. Let $d = 0.102$ inch, $r = 1$ inch and $f = 50{,}000$ pounds. Then:

found a starting point for our graduations and the other marks may easily be located with the proper scale, 1/6 that of r. The chart is now complete except for lettering. For convenience in reading I have given the d-line a double set of numbers, one for the diameters and the other for the corresponding gage numbers.

To read the chart draw a line between the selected values of r and d (say 0.8 and 0.204) and get the intersection with the r-d support. Connect this point with the chosen fiber stress (say 80,000). The intersection with P, which is at 166, gives the load the spring will carry.

An Alinement Chart Solving Five Variables

Next let us take a formula containing five variables instead of four. The principles involved are precisely the same as those already discussed; we merely carry the process one step further. For the sake of variety a slight change will be made in the disposition of the axes. The formula chosen for charting is the well known one by Lewis for the strength of gear teeth

$$W = s\, p\, f\, y$$

where W is the pitch-line load, s the fiber stress, p the circular pitch, f the face width and y a constant corresponding to the number of teeth.

Let us separate the right-hand side of the equation into two parts and construct a separate chart for each, one giving the product of s and y, and the other the product of p and f. Then, if we take the resulting product lines or supports as the outside lines of a new chart we will find the value of W (their product) on their support. See Fig. 4.

We must impose the customary limits on the variables in order to determine the size of the chart. Suppose we let p vary between ½ and 2 inches, and f between 1 and 6 inches. According to the tables which usually accompany the formula, s may vary between 1700 and 20,000, and y from 0.067 for a 12-tooth pinion to 0.124, for the rack. For the sake of simplicity we will suppose the application of the chart to be limited to the 15-degree involute teeth.

Take first the values of y. The logarithm of 0.067 is 2.8261, and of 0.124 it is 1.0934, giving a difference between the extremes of 0.2673; this multiplied by the scale unit chosen gives the graduated length of the axis. Pick out the values of y from the table, find their logarithms, and lay down the latter on the axis, making the lower end of the line the logarithm of 0.067. Lewis gives a formula

$$y = 0.124 - \frac{0.684}{n}$$

for calculating the value of y from the number of teeth. I have made these calculations and laid off the results on the other side of the line for purposes of comparison. It will be noted that the tabular values are spaced somewhat irregularly as compared with the calculated. This is a matter of passing interest, but the chief point to which I wish to direct attention is the ease with which empirical constants, which are connected by no known law, may be handled by these diagrams. There is no need of trying to force them to fit some arbitrary equation

for they may be inserted in the chart exactly as they were obtained from experiment. In lettering this line we place opposite the graduations the numbers of teeth corresponding to the different values of y, which we have plotted, instead of the y-numbers themselves. The former we know from our given gear, while the latter is of no special interest. This line from now on will be called the n- instead of the y-axis.

Opposite and parallel to this line we draw the axis for s, the fiber stress. The logarithm for its lowest value, 1700, is 3.2305, and for the highest, 20,000, is 4.3010, giving a difference of 1.0705. If we take a unit-scale value of one-fourth that used on the n-axis the two lines will be approximately equal. Taking the lower end of the line at any convenient point, mark it 1700 and graduate up to the top in the logarithms of the desired values of s. In lettering this line it might be well, in case the gears for which the chart is to be used are all to be of the same material, to place opposite the fiber stresses the appropriate speeds as shown by the table, thus making the chart entirely self-contained. Where several different materials are to be used this would probably cause a considerable amount of confusion, and it has therefore been omitted here.

The lengths of the scale units on the outside axes being 1 and ¼ we find the unit length for use with the support to be

$$\frac{1 \times \frac{1}{4}}{1 + \frac{1}{4}} = \frac{1}{5},$$

and the support will divide the distance between the axes into intervals whose lengths are 1/5 and 4/5 of this distance. We do not graduate the support since the numerical results of the multiplication are not wanted.

Next take the values of p and f; p varies from ½ inch to 2 inches. The corresponding logarithms are -0.301 and $+0.301$, making a total range of 0.602. The lowest value of f is 1 inch ($log. = 0$) and the highest 6 inches ($log. = 0.778$), making a total range of 0.778. Since these two lengths are so nearly equal we might as well use the same scale unit for each, and it will be found convenient to make it ⅕ that used on the n-axis. The support for the product will have a scale unit ½ the size of that used on the outside axis, or will be equal to 1/10 the length of that which was used on the n-line. This support and the one previously located are to be used as the outside axes for the last multiplication, whose product is W. The size of the scale unit on the W-line, since those on its outside axes are 1/10 and 1/5 is

$$\frac{\frac{1}{10} \times \frac{1}{5}}{\frac{1}{10} + \frac{1}{5}} = \frac{1}{15},$$

and the line itself will divide the distance between these axes in the ratio of ⅓ to ⅔.

It will be convenient to have the W-line fall between the diagrams used for the preliminary multiplications in order to avoid confusion. Therefore, locate it somewhat to the right of the n-axis and then draw a vertical for the support of the p-f diagram so that its distance from the W-line is ½ the distance of the latter from the n-s support. At convenient equal distances from the p-f support draw the p- and f-axes, and graduate them with the logarithms of p and f, using a scale unit ⅕ the size of that we used for the n-graduation. As before, we may locate the graduated parts of these lines anywhere we please on them.

The W-axis is now to be graduated, and its graduations, unlike the others, must start at some definite point. Solve

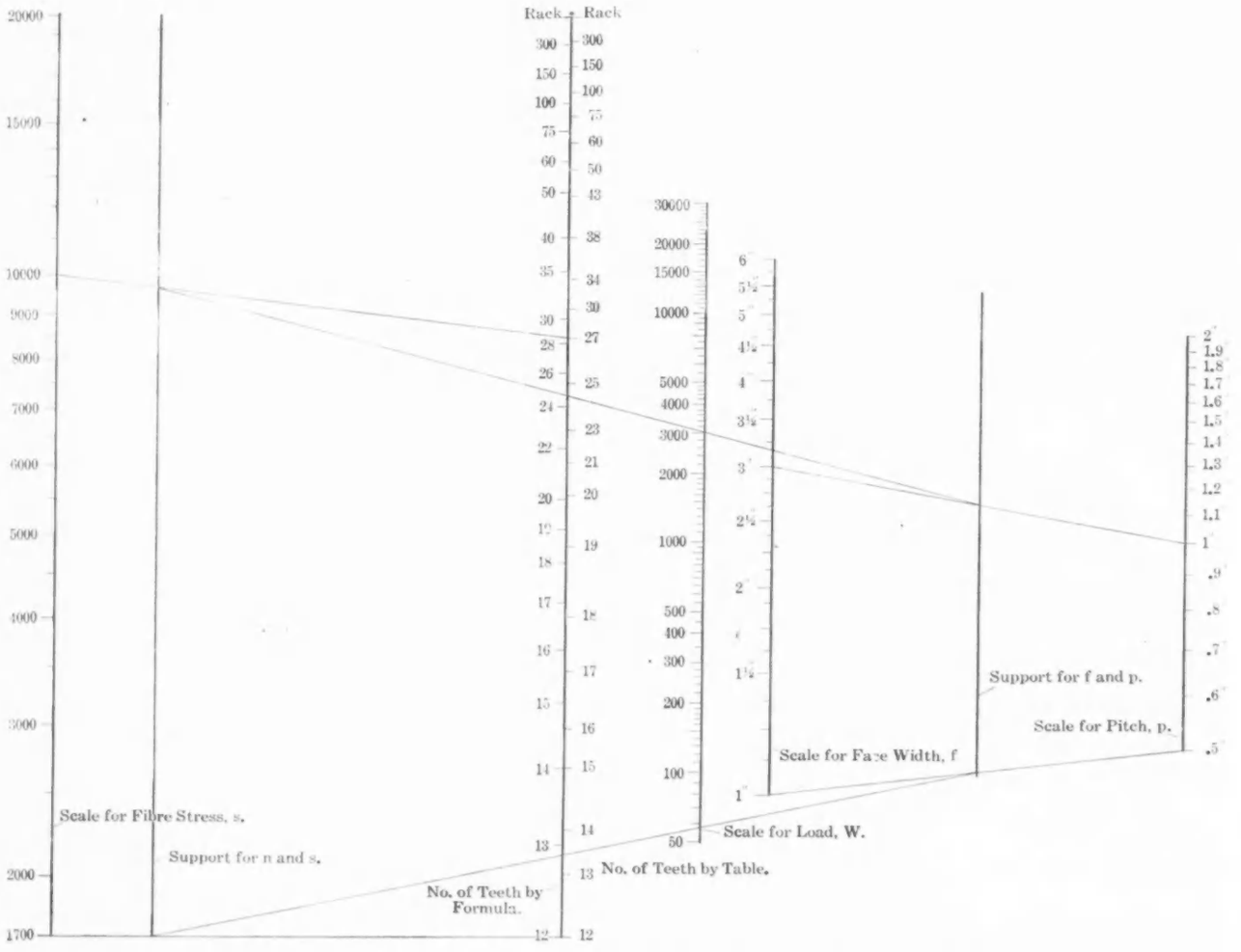

Rack
Rack
Scale for Fibre Stress, s.
Support for n and s.
No. of Teeth by Formula.
No. of Teeth by Table.
Scale for Load, W.
Scale for Face Width, f
Support for f and p.
Scale for Pitch, p.

FIG. 4. AN ALINEMENT CHART FOR THE STRENGTH OF GEAR TEETH, BASED ON LEWIS' FORMULA

the equation for any values within the prescribed limits. Take, for instance, $n = 12$, $y = 0.067$, $s = 1700$, $f = 1$ and $p = ½$. Then

$$W = 1700 \times ½ \times 1 \times 0.067 = 56.95.$$

On the chart join 1700 on the s-line with 12 on n, and get the intersection with their support, which will be at the product (unknown) of the two. Join 1 on the f-line with 0.5 on the p-line, and get the intersection with their support, giving

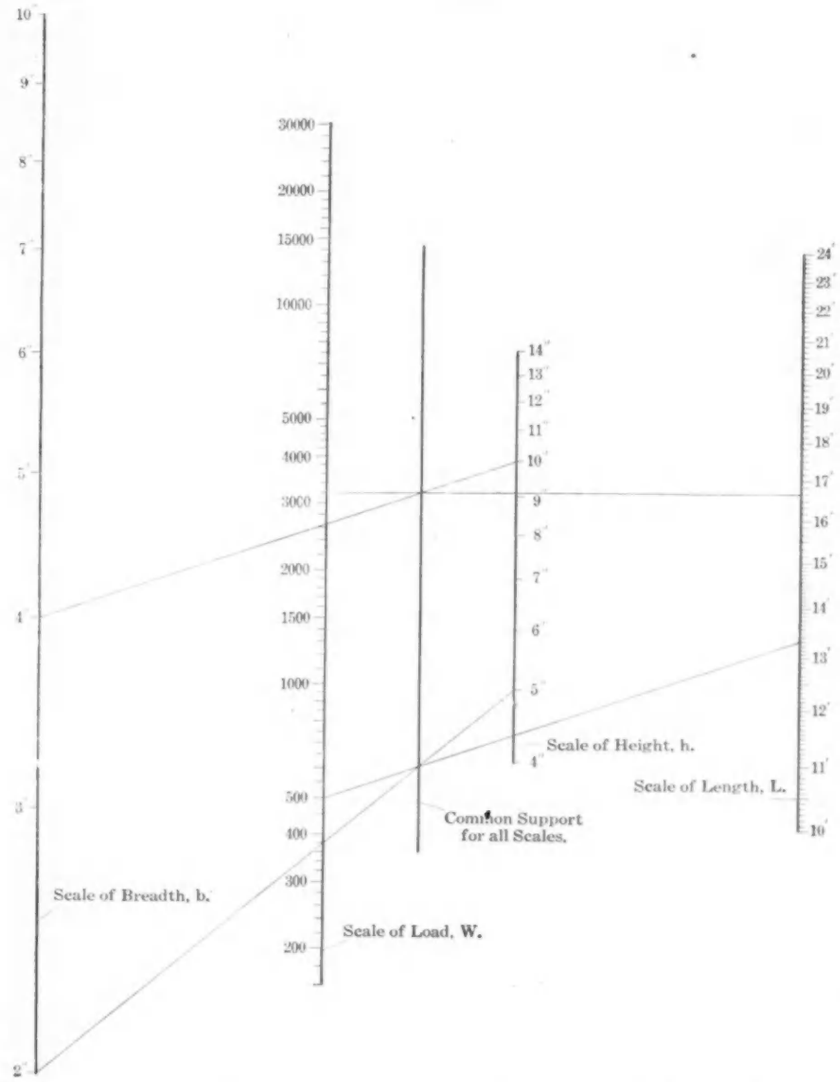


FIG. 5. AN ALINEMENT CHART PLOTTED FROM THE EQUATION $\frac{W\,L}{8} = \frac{b\,h^2}{6}\,f$

again the product (unknown). Join the product of n and s with that of p and f, and the intersection with the W-line must be the point corresponding to 56.95. Its logarithm is 1.7555. Lay an engineer's scale with the proper sized graduations (1/15 that used on the n-line) on the W-line so that 1.7555 on it is at the point we have located, and graduate the rest of the line from a table of logarithms. The method of using the chart should be obvious from what has preceded, but may be briefly recapitulated. Join the desired values on n and s, say, 27 and 10,000, by a straight line and mark its intersection with the support. Join the desired values of p and f, say, 1 and 3, by a straight line and get its intersection with their support. Join these two points by a third line and its intersection with the W-line gives the load, 3000 pounds, which the gear will carry safely.

I believe that a comparison of this diagram with others which have been published for the solution of this equation will show that it has some very marked advantages over them in point of clearness of reading and simplicity of construction. The only point which gave any trouble in construction was the selection of scale values for the different lines so that they might all be read from an ordinary engineer's scale. Several trials were necessary before they were finally settled on.

Enough has been said, I think, to indicate the general method to be followed in cases where the equation to be charted contains more than three variables, and there should be no difficulty in extending the method to any case where more than five—the largest number treated here—are involved. Before leaving this part of the subject, however, I wish to take up briefly another case, differing slightly from those which have gone before, and which is occasionally serviceable in special problems.

An Alinement Chart Plotted from the Equation for a Rectangular Beam

Suppose we have an equation of the form

$$\frac{W\,L}{8} = \frac{b\,h^2}{6}\,f.$$

This is the equation for a rectangular beam, supported at the ends and uniformly loaded. In it W is the total load, L the length of the beam in inches, b the breadth and h the hight of the cross-section of the rectangle, both in inches, and f the fiber stress.

Let us suppose for convenience that the beam is of white oak or long-leaf yellow pine for which the "Cambria" pocket book gives a safe fiber stress of 1200. Our formula may then be simplified to read

$$W\,L = 1600\,b\,h^2.$$

For our limits let us say that L varies between 10 and 24 feet, or 120 and 288 inches, b from 2 and 10 inches, and h from 4 to 14 inches. Then W will vary from about 178 to 26,100. Suppose, now, we construct two charts, one for multiplying W and L and the other for 1600 b times h^2, Fig. 5. The two products are to be equal. We may, therefore, use the same line as the support for each chart if the scale units on the supports for the charts have the same value. The base lines for the two charts may or may not coincide, but it is essential that they intersect the support at the same point if we expect the two index lines to cut it at a common point. This must be the case if the products of the two multiplications are to be equal as we have supposed. As in the previous illustrations, there is no necessity for actually drawing the base line. The general method of procedure in constructing this diagram is so similar to what has gone before that it will not be described in detail.

After finding the range of values required for the L-line we choose a convenient unit length and graduate the line in the logarithms of the desired values. The W-line is placed opposite it at any convenient distance and graduated with a scale unit whose length is one-quarter that used on L. The support for these lines must, therefore, divide the distance between them in the ratio of 1/5 to 4/5, and its scale unit will be

$$\frac{1 \times ¼}{1 + ¼} = \frac{1}{5}.$$

For the b- and h-lines it will be found that a scale unit of the same size as the standard used on L may be taken for b, and one of one-quarter the standard for h. These will give convenient lengths for the two axes, and their support will also have a scale unit of 1/5, since again

$$\frac{1 \times \frac{1}{4}}{1 + \frac{1}{4}} = \frac{1}{5}.$$

This is essential if, as remarked above, the products of the two multiplications are to be represented by equal lengths on the common support. Remember that when h^2 is plotted the lengths of the logarithms of h must be multiplied by 2. The scale units chosen for the b- and h-lines being 1 and ¼, the support must be distant from these lines in the ratio of 4/5 to 1/5. Lay off the b- and h-lines at any convenient distances from the $W = L$ support which will satisfy this ratio.

Graduate the b-line in the logarithms from 2 to 10 with a scale unit of 1. The h-line is to be graduated in twice the logarithms of the numbers between 4 and 14. The position of the graduations on b is chosen arbitrarily, but for h must be found a simple trial calculation, since the location of the base line is unknown.

Assume $b = 2$ inches, $h = 5$ inches, and $L = 160$ inches (13 feet 4 inches). Then

$$W = 1600 \frac{2 \times 25}{160} = 500.$$

Join 500 on the W-line with 160 inches (13 feet 4 inches) on the L-line and mark the intersection with the support. Through this point of intersection draw another line so as to pass through 2 on the b-line. Where this line intersects the h-line must be the point numbered 5. Its logarithm is 0.699. Knowing this and the proper scale length we may easily find the other points on this line. To read the chart draw a line between the chosen values of W and L and mark its intersection with the support. Any line drawn through this point to the b- and h-axes will intersect them in values which will give the necessary strength to the beam. Thus, on the chart, the solution has been found for the case where $W = 3200$ and $L = 200$ inches (16 feet 8 inches). It is found that a beam 4x10 inches will satisfy the conditions as to strength.

An Alinement Chart with Curved Support

Next let us consider a case in which the support is curved. Let the equation take the form

$$S = V t + \frac{g t^2}{2}.$$

This is the equation for the space passed over by a body falling under the influence of gravity and starting with an initial velocity. In it S = the space moved over in the time t, V = the initial velocity, and g = the acceleration of gravity, which we will call 32.

The formula has but little interest for the practical man, but is chosen because its form is a good one for the purpose of illustrating this type of chart. Let us write it

$$S = V t + 16 t^2,$$

or

$$-V t + S = 16 t^2.$$

Make

$$u = -l_1 V \text{ and } v = l_2 S,$$

then

$$V = \frac{u}{-l_1} \text{ and } S = \frac{v}{l_2}.$$

Substituting above we have

$$\frac{u t}{l_1} + \frac{v}{l_2} = 16 t^2.$$

or

$$l_2 t u + l_1 v = 16 l_1 l_2 t^2.$$

This is evidently identical with the fundamental equation for the alinement diagram in my previous article. From equations (7) and (8) given there for y and x we have

$$y = \frac{16 l_1 l_2 t^2}{l_1 + l_2 t},$$

and

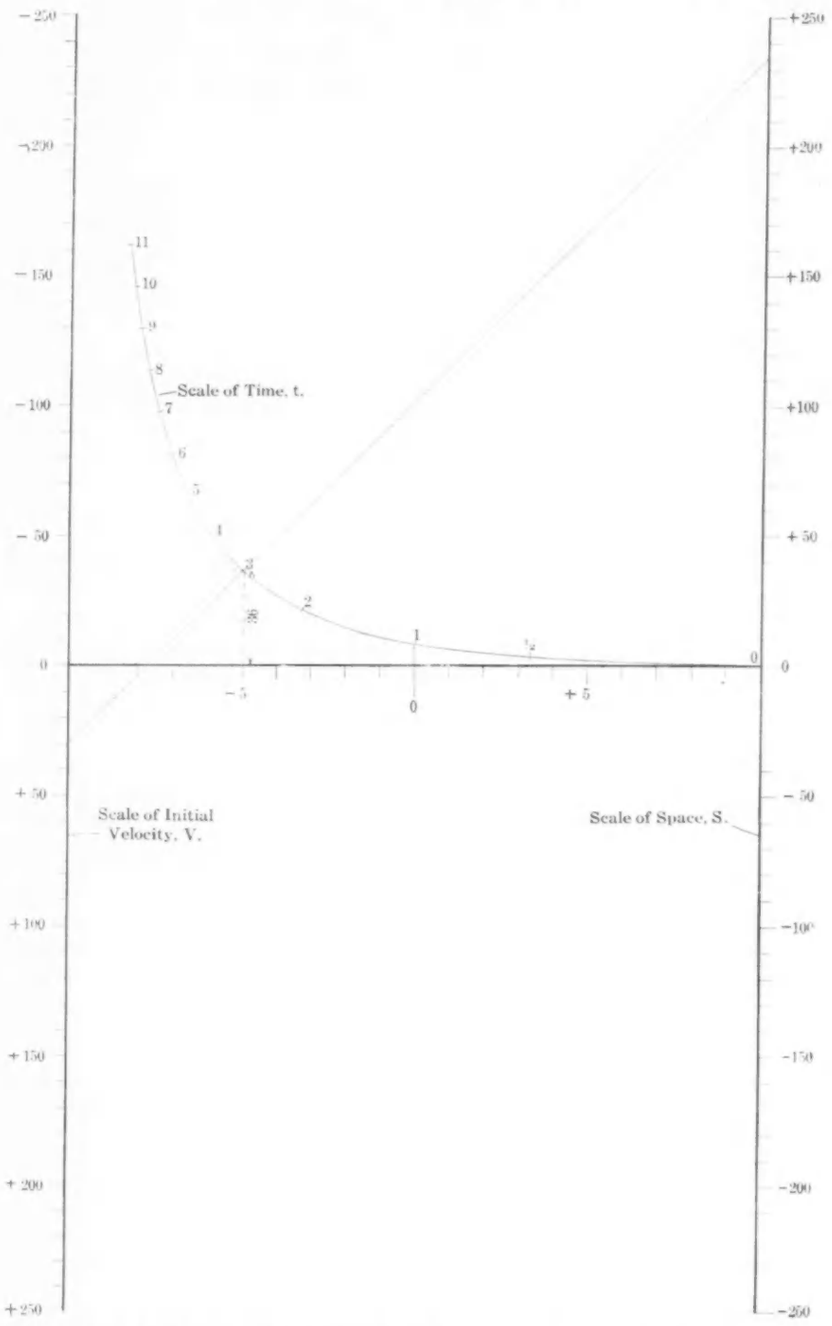


FIG. 6. AN ALINEMENT CHART WITH CURVED SUPPORT, SOLVING THE EQUATION

$$S = V t + \frac{g t^2}{2}$$

$$x = d\,\frac{l_1 - l_2\,t}{l_1 + l_2\,t}.$$

These are the equations of the points constituting the support.

The choice of the scale units is of little or no importance in this case, as it is not supposed to have much practical value. For simplicity in calculation then let us take $l_1 = l_2$.

Then

$$y = 16\,l_1\,\frac{t^2}{1+t}$$

and

$$x = d\,\frac{1-t}{1+t}.$$

Here our formula does not have a logarithmic form, and we can, therefore, graduate our scales in lengths proportional to the numerical values of the quantities involved and not of their logarithms. This has been done on the scales for V and S. It should be observed that since the modulus for V, or l_1, is negative, the positive values of that quantity are measured down from the base line. The distance between the axes may be anything we like, but to simplify our calculations we will make it 20 of some unit in order that the half distance, or d, may be 10.

Solve the equation

$$x = 10\,\frac{1-t}{1+t}$$

for as many values as are wanted. In the chart shown in Fig. 6 the values taken for t were 0, ½, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 and 11. The corresponding values of x are 10, 3.33, 0, —3.33, —5, —6, —7.15, —7.5, —7.78, —8, —8.18, —8.33. For the same values of t we have for y: 0, 2.6, 8, 21.3, 36, 51.1, 66.6, 82.2, 98, 113.8, 129.5, 145.2, 161.4.

Plot the curve for these values of x and y, and letter it to correspond with t. The construction for the point $t = 3$ has been indicated by dotted lines.

If we connect two points on the outside axes by a straight line the intersection of this line with the curved support will give t, or by connecting the initial velocity V with the time on the curved support we read on the S-line the distance passed over. This has been done in the figure for $V = 30$ and $t = 3$, giving the value for S as 234. By making the index line pass through $V = 0$ and the given time we get a case corresponding to the simple law of falling bodies. If V be taken negative we may get two intersections with the t-line, and either of the times thus found will satisfy the equation.

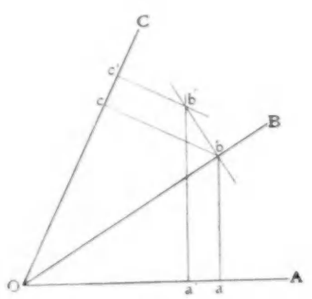


FIG. 7

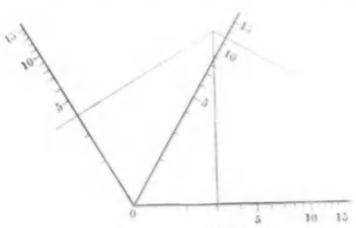
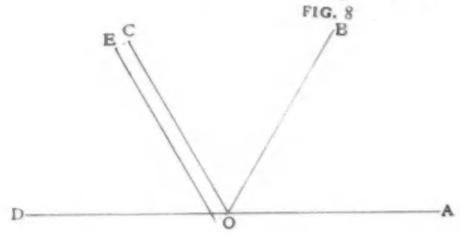


FIG. 8



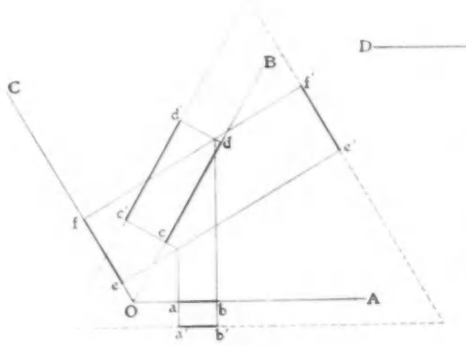


FIG. 9

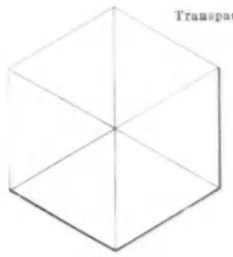


FIG. 10

DIAGRAMS ILLUSTRATING THE HEXAGONAL INDEX CHART

The Hexagonal Index Chart

A type of chart of quite a different character from any of those previously described will now be considered. Suppose we have a diagram like Fig. 7, where AOC is any angle whatever, and OB its bisector. Measure equal distances Oa and Oc on the OA- and OC-axes and erect perpendiculars ab and cb. They meet, of course, on OB. The length $Oa = Oc = Ob\ cos.\ AOB$, or $Oa + Oc = 2\ Ob\ cos.\ AOB$.

Now suppose b moved out to b' on the perpendicular bb'. Project b' to a' and c'. Then since bb' makes the same angles with OA and OC, its projections on these two axes will be of equal length, or aa' will equal cc'. Therefore,

$$Oa + Oc = Oa' + Oc' = 2\,OB\ cos.\ AOB.$$

We have here, evidently, a new form of addition chart. If the scale values on OA and OC are equal, and that on OB is this unit times $\frac{1}{2\ cos\ AOB}$, the length OB measured to this unit is equal to the sum of Oa' and Oc'. If AOC is 90 degrees the unit length for the OB-axis is that used on OA multiplied by $\frac{1}{\sqrt{2}}$, and if AOC is 120 degrees the unit lengths on all three axes are the same.

If we were to graduate the three axes with their proper units and then erect perpendiculars to the axes at the division points we could find the sum of Oa' and Oc' by finding the perpendicular from OB which passes through the point of intersection of the perpendiculars from a' and c'. It will readily be seen, however, that this would entail a very confusing network of lines, and it is, therefore, customary with this form of chart to use what is known as a transparent index. It consists of a transparent sheet, preferably of thin celluloid, on the lower side of which are ruled three lines meeting at a point: each line is perpendicular to one of the axes. The axes having been properly graduated, the index is laid on the chart (care being taken that the index lines are perpendicular to their respective axes) and is so adjusted that one perpendicular passes through the selected value on OA, and the second through that on OC. The third perpendicular will then intersect OB at the sum of the two quantities. The angle AOC may be anything we like, but since we get equal scale units on the three axes with an angle of 120 degrees, it is advantageous, in general, to use that value. Where this is done the arrangement is known as the "hexagonal" type. The whole thing is so simple and self-evident that it scarcely seems to call for an illustrative example, and I will, therefore, not attempt to do more than refer to some of its more important peculiarities.

Like the other forms of addition chart already examined, it may be turned into a chart for multiplication by graduating the axes in the logarithms of the numbers instead of the numbers themselves, Fig. 8. When the graduation of the middle or OB-axis is identical in general form (not necessarily in length) with those on the side axes it may be projected from them by parallel lines whose angle with OA or OC is the supplement of the angle which OB makes with them. This is a convenience in case the angle OAC is, say, 90 degrees, as it does away with the necessity for a scale whose unit length is $\frac{1}{\sqrt{2}}$ times that used on OA and OC.

It will also be noted by reference to Fig. 9 that the graduated lengths on the three axes may be moved as far as we please in a direction *perpendicular* to these axes without changing the points at which the index line cuts them. This is sometimes an advantage in that it allows us to shift our scales so as to get a more compact and convenient arrangement of the chart than is always possible if the axes are to meet at O. For instance, suppose we wished to arrange the three scales on the sides of an equilateral triangle, shown dotted in Fig. 9. It is plain that we get precisely the same results with the lines $a'b'$, $c'd'$ and $e'f'$ that we do with the lines ab, cd and ef, i.e., if $ab + ef = cd$ it is likewise true that $a'b' + e'f' = c'd'$. It is also advantageous in case any of the quantities is affected by a number of different coefficients. In this case it is only necessary to draw a separate parallel line for each value of the coefficient multiplied into the variable, and graduate it with the product of the two. Then, taking the line affected by the desired coefficient, pick out the required point on it and pass the index line through this point.

This form of chart may be arranged easily to take care of a larger number of variables than three. On Fig. 10 the product of OA and OC will be found on OB. If we draw a new axis OD, making an angle of 120 degrees with OB we have a new diagram on which we may obtain the product of OB and OD. The product will be read on OC, or any line, as OE, parallel to it. This operation may be repeated an indefinite number of times, and it is here that the advantage of being able to move the scales in a direction perpendicular to themselves becomes most apparent. It enables us to handle a large number of variables and have a separate scale for each one of them.

In problems of this sort it is an advantage to have a transparent index made in the shape shown in the same figure. It is a hexagon with the sides parallel to the index line. This chart takes its name from the shape of this index sheet. After setting the index to get the product on OB, place a straight-edge against the side parallel to the OB index line, and it is easy to slide it into position for the next reading without losing its orientation, and at the same time always keep the index through the point last found on OB.

A Modification of the Preceding Type

Personally, I must confess, the method of the transparent index does not appeal to me very strongly. It has the disadvantage of not being self-contained, and unless we provide a special index for each chart the two are not likely to be found together when they are wanted. In the second place, it is easier to "fudge," or force, the index to give desired results than with most of the other types. Still it must be admitted that it has its advantages in certain cases, and I have had one or two problems to chart which it seemed impossible to handle with any approach to simplicity by any other method.

A form of chart bearing a family resemblance to both the hexagonal and alinement types is shown in Fig. 11. In it the axes OA and OC make any angle,

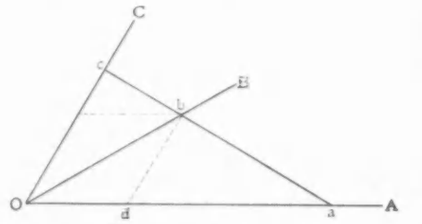


FIG. 11. DIAGRAM ILLUSTRATING A MODIFICATION OF THE HEXAGONAL INDEX CHART

and OB bisects it. Draw any line ac. Then from similar triangles we have

$$\frac{Od}{Oa} = \frac{Oc - bd}{Oc},$$

or

$$\frac{Od}{Oa} = 1 - \frac{bd}{Oc}$$

and

$$\frac{Od}{Oa} + \frac{bd}{Oc} = 1.$$

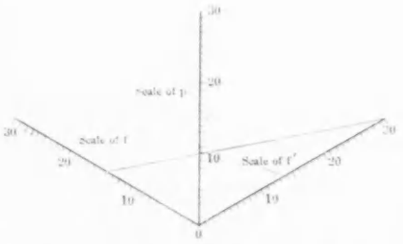


FIG. 12. CHART PLOTTED BY METHOD ILLUSTRATED BY FIG. 11

Now

$$Od = bd = \frac{Ob}{2\cos. AOB}$$

$$\therefore \frac{1}{Oa} + \frac{1}{Oc} = \frac{2\cos. AOB}{Ob}.$$

The simplest case is where the angle AOB is 60 degrees; then $\cos. AOB = \frac{1}{2}$ and

$$\frac{1}{Oa} + \frac{1}{Oc} = \frac{1}{Ob}.$$

This is in reality the "reciprocal" form of the type just described.

The equation we have derived is of the same form as that which was used in plotting the chart, shown in Fig. 7, of the former article

$$\frac{1}{f} + \frac{1}{f'} = \frac{1}{p}.$$

As a matter of interest, this has been recharted by the new method. In Fig. 12, f and f' are graduated on the outside axes and p on the middle. To read the chart join up points on two of the axes which are known and get the intersection of the line with the third. This will be the value necessary to satisfy the equation.

The 60-degree arrangement of the axes is not quite so satisfactory in this type of chart as in the last described, since when we are working out toward the limits, the index line is likely to cut some one of the axes at an angle which is disagreeably acute. For this reason it is generally considered that the advantage lies with a smaller angle even if the work of graduating is somewhat more difficult.

Where the two outside axes are graduated alike the central axis may be marked off without much difficulty by simply joining like points on the outsides. The marks thus found on the middle axis will have numbers whose values are one-half those on the outside lines. This form of chart might be used for multiplication by plotting the reciprocals of the logarithms of the numbers to be multiplied on the outside lines and of their products on the middle. The advantages of such an arrangement are not very apparent, however, and it has but little practical interest.

An Unusual Piece of Machinery

By John E. Sweet

There has been built by the Straight Line Engine Company a machine designed by O. C. Kavle, which has a number of shafts, gears and cams, and a crank, connecting rod and slide. As the shafts are 1½ to 2 inches in diameter, they are of soft steel, ground, lapped and scraped into cast-iron boxes; the connecting rod is brass and the slide cast iron, running in cast-iron guides. The shafts are a tight wringing fit in the boxes, as are the crank and cross-head pins in the connecting rod and the slide in the guides. The machine runs smoothly at 200 revolutions per minute without the bearings showing the least evidence of heating or abrasion. Mr. Kavle tells me he ran a shaft about ⅜ inch in diameter 13,000 revolutions per minute for some months with such a fit, and without a particle of oil; when examined, it showed a burnished appearance. His theory is that no grit can get in, and it has no excuse for doing anything else but go.

An authority states that the best test for cylinder oils is to heat them in a current of air for one hour at the temperature corresponding to the steam pressure at which they are to work. The loss in weight should not exceed 0.5 per cent.

In 1907 the output of lumber in the United States amounted to 40,256 million feet, board measure. In 1906 the output totaled 37,551 million feet. Thus 1907 scored a gain of 2705 million feet, or 7.2 per cent. over 1906.

Several Interesting Shop Practices

Modern Methods of Making Circular or Worm Racks, of Using Planer Jigs, of Supporting Planer Tools and Using Babbitting Jigs

EDITORIAL CORRESPONDENCE

One of the neatest methods we have seen for making circular or worm racks is that employed by the Becker-Brainard Milling Machine Company, Hyde Park, Mass., and illustrated in Fig. 1. In the case of the large rack shown, they cast a six-lobed cylinder, which is shown mounted in the fixture on the lathe carriage. The number that are cast together depends on the size of the rack and also the diameter of the worm which is to engage in it.

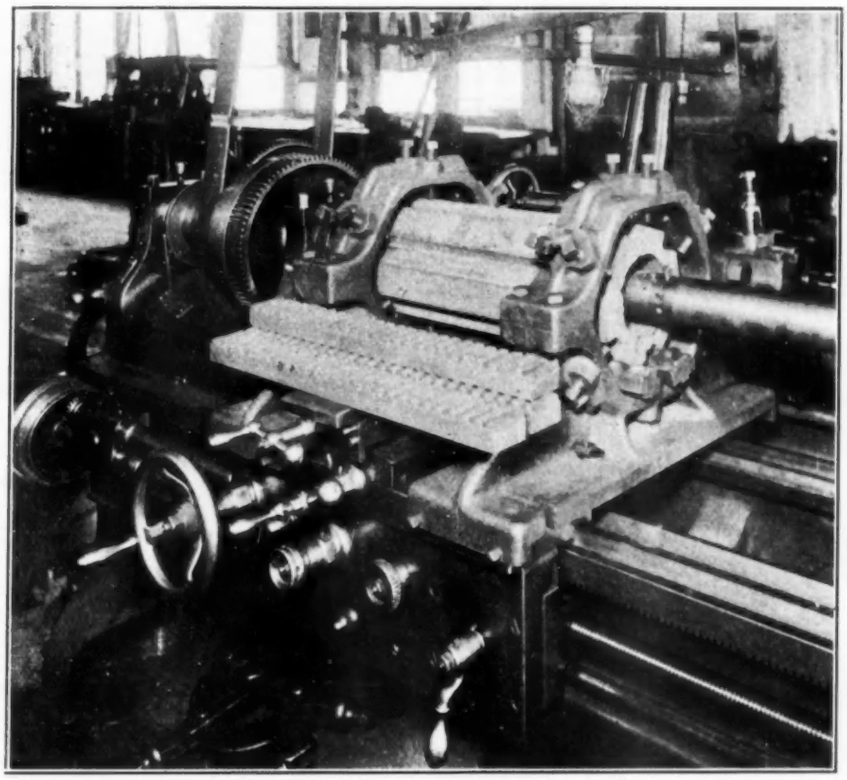


FIG. 1. A NOVEL WAY OF CUTTING RACKS FOR WORMS

Mounting this casting in the fixtures shown at each end of the lathe carriage the inside is bored with an ordinary boring bar carrying a fly cutter, while the work is fed past the cutter by the lathe carriage. After it has been bored the lathe is geared to cut the desired thread and the thread is chased on the inside of the casting by a single-point tool, which is fed out from the bar for each cut, the work being fed by the carriage instead of revolving the lathe, as in ordinary screw cutting.

The casting then goes to a milling machine, is milled on the back of each rack and a pair of slitting saws set to the right distance apart for the width of the rack, are run over each section, but do not cut through into the thread on the inside. After they are all cut nearly through by a second operation, the casting is removed from the machine and simply dropped on a hard surface when it falls apart, leaving the six complete racks and the six small segments of waste which have been cut out between the saws. They require very little trimming up, and it makes a very easy method of doing a rather difficult job.

Large Babbitting Jig

A very good example of a babbitting jig for securing the alinement of a number of bearings is shown in the accompanying illustration, Fig. 2, which was secured from the shops of the John T. Robertson Company, of Hyde Park, Mass., through the courtesy of their superintendent.

This is a paper-box machine and the babbitting jig consists of the central frame, which is clamped to the body of the machine itself by the four *C* clamps shown. This frame carries the two horizontal shafts shown in front and also two vertical shafts at the back, one of which can be seen through the opening in the frame itself over the upper horizontal shaft and the other is in a corresponding position at the left.

After the frame or jig has been carefully lined up with the body of the machine itself, so as to bring the different shafts in their proper positions, shells are put in place, the bearings to be poured are luted with clay, as shown, and the babbitt poured in the bearings. The shafts can be easily removed for heating before pouring and also after the bearing has cooled by the use of the slotted straps shown. This insures all fixed bearings being correctly located with regard to each other, and saves a large amount of time in scraping and fitting.

Large Planing Fixtures

Another example of this kind is shown in Fig. 3, and is one of the best cases of large jig planing we know of. Here six large milling-machine knees are hung on the planer bed at one setting and both of the heads brought into operation. These are large pieces, each of the jigs shown being about 30 inches high.

The top faces of these knees are first planed with their proper dovetail, and the jigs are made so as to clamp them on this surface. The jigs are first carefully lined up with the bed so as to be perfectly square in both directions, and after this it is an easy matter to swing the castings into place and slide them down into the jigs by means of the overhead crane which serves this planer. By substituting different widths of shoes at the sides these jigs can be used for several sizes, the shorter knees being blocked up from beneath so as to bring the surfaces to be planed up above the top of the jig.

It will be noted that one side of the bearing being planed is the regular 45-degree dovetail, while the opposite side is about five degrees in the other direction. This allows for the clamping gib to be drawn down against the other side of the dovetail on the column of the machine, and makes a very rigid connection between the knee and the column.

At the front of the bed lying over the open-ended wrench is the gage for planing these openings. One end, it will be seen, fits the 45-degree dovetail, and the other the five-degree angle for the gib, and these are planed until this gage just goes into place. The other gage lying in the foreground makes it easy to locate the 45-degree side of this cut in relation to the bearing already planed on the other face or top of the knee. The hardened steel shoe on the end of this gage fits over the

angle of the dovetail on that side, and the 45-degree cut in the gage showed exactly where this bearing should be planed to. The front side of the work is chalked and a line scribed as a general guide for this planing, but the final cut is taken by setting the tools against this gage block, as then it is certain that this side of the bearing will be in the right relation to the dovetail on the top of the knee. After

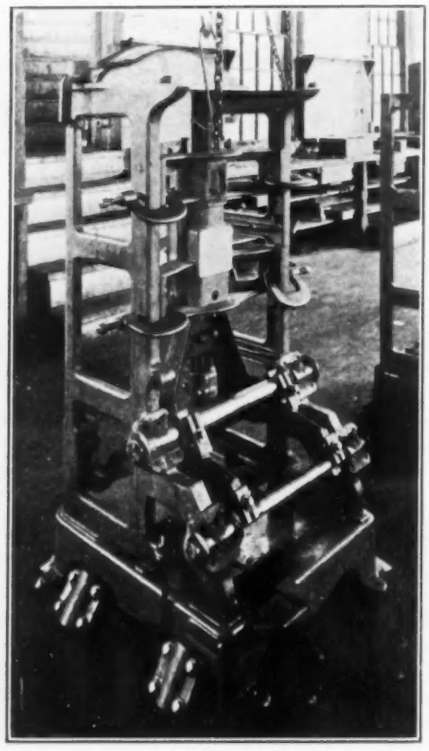


FIG. 2. LARGE BABBITTING JIG

this side is correctly planed, the long gage is used to determine the exact location of the other side of this bearing.

Using Planing Gages

The use of planing gages is very clearly shown in Fig. 4, and those who are not familiar with this way of planing to the correct size will find it both interesting and instructive. It does away with all but the preliminary laying out, which is, of course, necessary with the first surface planed in order to have the castings clean up along its entire length. But after the first surface has been correctly planed these gages enable any good man to get very accurate results and practically cut out all chance of making mistakes.

In this case the inside or column dovetails have been planed first, and the knee is simply slipped down over a form or angle plate, which represents the column of the milling machine itself. In setting this angle plate it is, of course, necessary that great care should be taken to have it square with the planer table in both directions, but after this is done no further attention need be paid to this end of the work, and the knees to be planed are clamped to this plate and supported at the outer end in any way that will prevent springing under the cut.

The gage shown in place has a dovetail projection at the back which just fits inside the planed surfaces of this bearing of the knee, and has been carefully laid out so that the angular sides shown in front are in exact relation to the dovetail projections which are slid into the fixture. This gage is put in place after the top surface of the knee has been planed, and all that is necessary is to set the planer head at the desired angle, 45 degrees in this case, and plane the angular sides until these sides are a continuation of the angular sides of the gage. When this is accomplished on both sides of the knee the planer hand knows without measuring that they are correct and will fit the table which is to be mounted on them.

The other gage shown lying on the planer table is used in a somewhat similar way, being located in front of one or more carriage slides, and the dovetails planed until they match the dovetails of the gage. Both the work and the gage are located by a steel strip which fits the planer-table slot and also the slot in the work and in the gage.

Supporting Overhanging Tools

It is one of the first principles of planing, or, in fact, of almost any machine work, that the cutting tool should be supported as rigidly as possible, and the overhang reduced to the lowest point. There are many cases, however, where on account of projections on the piece to be planed it is absolutely necessary to have the cross-rail of the planer at a considerable hight above the surface to be planed, in order to clear this projection. This means overhang in spite of anything we can do, and to offset this we make planer tools with long, heavy shanks so as to be stiff as possible. Even with this,

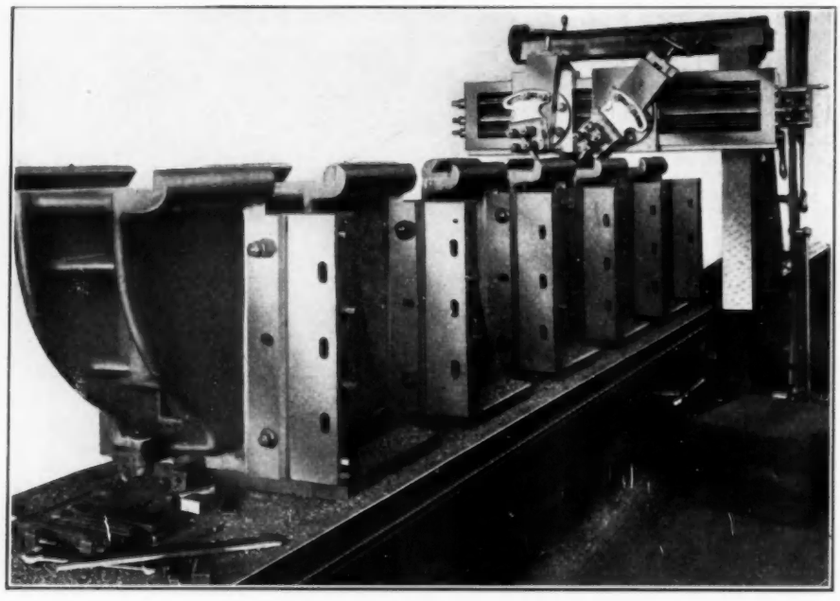


FIG. 3. STRING OF LARGE PLANING FIXTURES

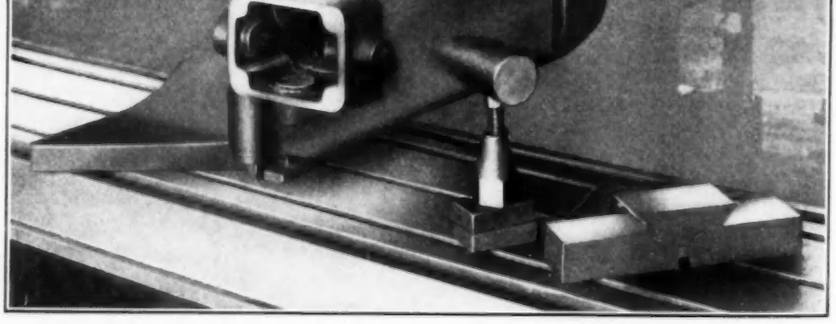


FIG. 4. ONE FORM OF PLANER JIGS

however, it usually prevents the taking of a good cut on account of the spring of the tool, and as a cure for this disease we recommend the treatment shown in Fig. 5. This is a strongly ribbed arm which projects from the side rail and carries an adjusting screw in the end so as to make a positive support for the shank of the tool, or the tool holder in this case, as close to the cutting point as is possible. While this is not as good as though the entire overhang could be avoided, it is a decided improvement over the usual method of support and allows a fairly good cut to be taken, and also makes it possible to secure a more accurate job. This is a large piece of work, as can be seen from the two-foot rule, standing inside one of the ribs under the base, and while it may not be possible to adopt this particular form of tool support in all cases, it gives an idea which can be adapted to suit many conditions. In this case it is connected to the elevating screw of the cross-rail so that it can be easily moved into any desired position. One of these on each side makes it possible to use two cutting tools and get good results from them both.

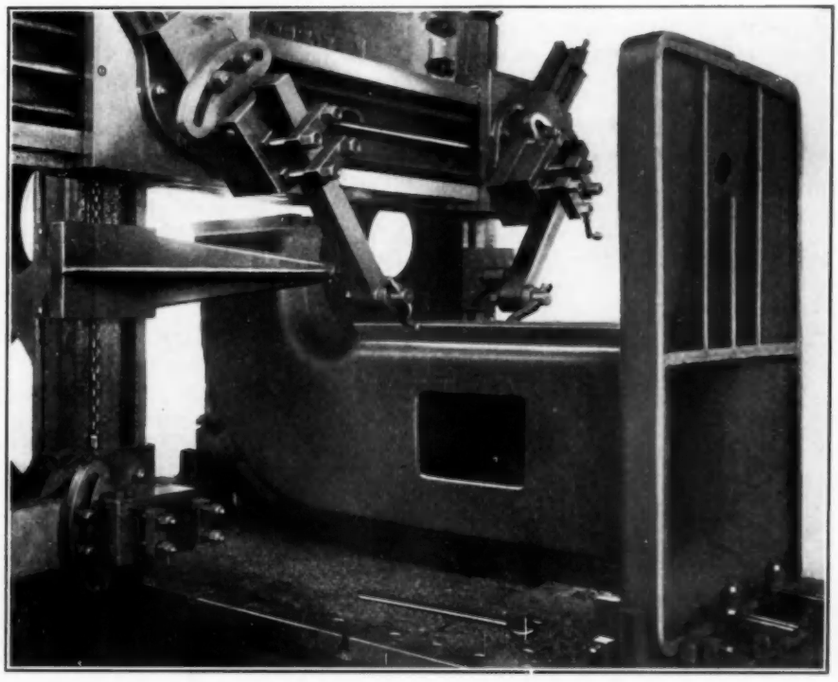


FIG. 5. SUPPORTING OVERHANGING TOOLS

J. H. C.

The following conclusions were arrived at as a result of some exhaustive tests made in connection with the question of weathering coal. Stored for a considerable time under water coal does not lose in heating value to an appreciable extent. Dry storage under cover seems to have no advantage over storage in the open, and in cases where loss is sustained after a period of about five months it becomes unappreciable.

Trade Opportunities in Colombia

By M. de Moreira

The remarkable location of Colombia with relation to both the Atlantic and the Pacific ocean gives a great opportunity for the development of American export. Though not as valuable a country for machinery as some other South American republics, still it deserves the attention and study of the American manufacturer. So far, exports from the United States, though highly satisfactory (31 per cent.), do not include machinery of any kind; our manufacturers should not leave that field to their English and German rivals, who thus far have supplied all the machinery for railroads, shipbuilding, etc.

Colombia's great handicap is her lack of transportation facilities. This is now being remedied as much as possible by the government. Concessions have been granted with the result that 12 different railroads are now under construction. Three hundred and fifty miles now constitute the total length of the working railway lines.

Railroad repair shops are few, but taking as an average one repair shop for each of the new lines actually under construction, we have 12 repair shops needing machine tools which American manufacturers can supply if they take the necessary steps to that end. The line leading from Cauca to the port of Buenaventura on the Pacific coast is for us the most important and the one toward which American manufacturers of machine tools and machinery should bend their efforts to furnish the material needed. Its importance is due to its proximity to the Panama canal and also to the rich coal deposits which have been found near its course. It is believed that the exploitation of that mine will pay for the expenses of the road and also leave a large profit. The American manufacturer should have a two-fold interest in that line: its proximity to the Panamal canal, which will facilitate shipping materials, and the opportunity of selling machine tools and mining machinery.

Modern machinery and appliances are found in Colombia on a very small scale and uptodate American machinery once known will have an immediate sale. The transportation on the river Magdalena is made entirely by steam launches, the greater part of which are bought in Europe, some however, are built in Colombia. The repair shops at the different points of the river need more labor-saving machine tools which American manufacturers are able to supply.

Of course, mining machinery is greatly needed in Colombia, as labor is scarce and not skilled. Gold, platinum, silver and copper are mined in a very primitive form and European nations seem to have devoted their efforts to railroad and general supplies and have let alone this field which offers great opportunities.

Materials for sawmills have lately been purchased from England, not because the Colombians did not know about the American machinery but for reasons which I think worth while relating: An order for a full sawmill equipment in Barranquilla had been placed in the United States and prompt shipment requested. Four months later the material arrived, the only excuse for the delay was as the manufacturer wrote, "the rush of business at home." On account of this rush the outfit had not been tested by the manufacturer and defects existed in the engine and saw, necessitating the sending of the defective parts to the repair shops, which resulted in another delay of two months, heavy expenses and the loss of a lumber contract. The circular saw was damaged and a new one had to be ordered. It came six months later without shipping documents, and no notice of any kind had been sent to the customer of this shipment, though he had written more than once asking for this information. The unclaimed saw, after one month in the custom house was sent back to the shipper. The unbusiness-like proceeding of the American manufacturer obliged the Colombian buyer to purchase all of his material in Europe and naturally did not help the export of American firms who solicited the Colombian trade at the time. I could give a dozen similar facts.

English and German manufacturers who are largely dependent upon export trade are most painstaking to secure satisfaction once an order is given. They study the people, their needs and their banking facilities and make satisfactory arrange-

ment as to credits. They are expert exporters and strictly follow instructions as to packing and shipping. The American manufacturer, on the other hand, seems to export only when he has time; that is to say, when the rush at home is not too great.

Banking facilities are the same as in other South American republics. Though all the foreign business houses are either English or German, a good American salesman can easily obtain the financial standing of any firm, as bank officials, following a different system than here readily disclose to a courteous salesman the standing of any firm big enough to give a large order.

The present time is a good one to seek orders with Colombia; the country is prosperous and needs machinery and machine tools. The people are awakening every day to the comforts one can obtain with the help of modern inventions. A short time ago two Colombians talking to me, told me that in Cartagena and Barranquilla plans were made for the establishment of ice plants. Another opportunity for our manufacturers!

In short, railroad supplies, machine tools for railway and maritime shops, mining machinery, sawmills, shoe-factory equipment, machinery for petroleum refineries and for packing house and ice plant form the list of products that American manufacturers can export to Colombia.

Will they try to place their goods in that market?

Blanking and Drawing Shells at One Stroke of a Single-acting Power Press

By W. J. Murphy

The accompanying sketch shows a method used successfully by one large concern for the rapid production of shells similar to Fig. 1 in a single-acting power press. Referring to the sketch, *A* in Fig. 2, represents the frame of a regular power press, while *B* represents the plunger or slide with up and down movement; *C* is a solid tool-steel combination blanking and forming die, the recess in the center being used for drawing the cup over tool-steel post *D*. The cutting die *E* is placed and located by set-screws and dowels in cast-iron die holder *F*, which in turn is held to the bolster plate of the press by studs *G* and *H*. *K* is a stripper to push the cup from the vertical post after the forming operation is completed. The portion of part *K*, which is marked *K*-1, is in the form of a horseshoe, while portion marked *K*-2 is a handle. Part *K*-2 is often connected to the plunger of the press with a bell-crank lever motion, thereby allowing the caps to be automatically knocked off on the upstroke of the press.

In addition to the above these tools are provided with a stripper for use in connection with the sheet metal as it is fed in from the reel. This allows the use of an automatic friction or ratchet roll feed, thereby allowing the operator to take care of more than one machine.

The size of the shells manufactured mostly with this equipment vary from 0.010 to 0.050 inch in thickness; from ⅛ inch to ⅞ inch in depth and from ¼ inch to 1½ inches in diameter respectively. Each shell included in the sizes cited above is done at one stroke of the press either from sheet steel, silver, gold, copper or brass. In making the drawing longer an allowance of about 0.003 inch should be made for clearance between the stock and the forming punch and die. A fine hole should also be left running through the center of drawing post *D* in order to prevent any air pressure occurring during the formations of the cap. The other parts are extremely simple to make and it is feasible to perform the work either in an inclinable or upright press.

The output of a press with automatic feed on the smaller sizes varies from 110 to 140 per minute, while the output on a machine fed by hand ranges from 50 to 90 per minute.

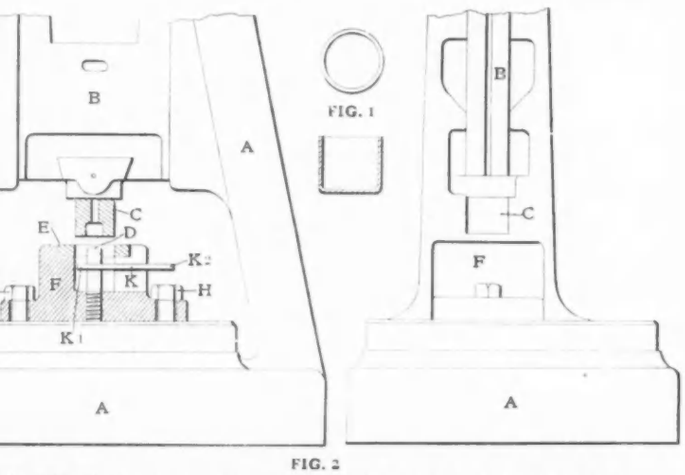


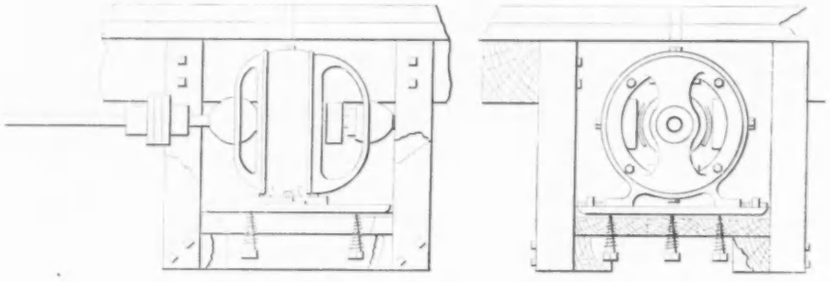
FIG. 2

PUNCH AND DIE ON PRESS TO BLANK AND DRAW SHELLS AT ONE STROKE

Placing and Alining a Large Motor

By J. G. Zimmerman

A 1000-pound electric motor was to be placed in a cradle at the ceiling to drive a line shaft already in place. The location of the motor was such that it could be worked at from only one side; the other three faced walls. The large size of the motor made it impossible to raise it with block and tackle from a hook because the diameter was so great as to make its top come within ½ inch of the ceiling, and the line shaft was set as low as possible consistent with good practice.



PLACING AND ALINING A LARGE MOTOR

We finally decided to drill a ¾-inch hole through the ceiling and use a portable crane on the floor above, letting a rope down through this hole and attaching it to the motor so as to leave no free space between it and the top of motor. The carpenters built the cradle but did not fasten the flooring. The motor was then drawn up so as to touch the ceiling and the flooring was slid into place. By this means we found on lowering the motor that the center of its shaft fell ⅝ inch below that of the line shaft. To line them up and have the motor level was our next problem. This was easily accomplished by the use of three lag bolts. The flooring was thick and by driving the three bolts upward in the form of a triangle we soon had the motor level and in line. When the flooring was bolted and proper shims put under the sliding base the job was successful in every way. The illustrations show clearly the scheme.

Practical Letters from Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

Locating Jig-leaf Pin-holes

In the old way of locating jig-leaf pin-holes I have noticed that the toolmaker often places his jig on the milling machine, locates the front hole first and then bores through, and so with the last hole a lot of time and skill are required to bring the holes accurate and in line. Another way is to set the job up on the face plate of a lathe, and, of course, this means a lot of work indicating and balancing the jig.

The readers of the AMERICAN MACHINIST who are familiar with this kind of work can readily see the trouble involved in performing this operation. The scheme shown herewith is both a time and trouble saver.

The first step to take is to strap the jig down on the milling machine in line with the spindle. After this is done place the adjustable fixture *A* up against the front face of the jig and adjust *B* to suit the horizontal location of the hole and then tighten up screw *C* to hold this firmly. Second, place the vertical bracket *D* in the right position to suit the hight of the holes to be drilled and tighten screw *E*. The fixture is then in the first position indicated in the drawing.

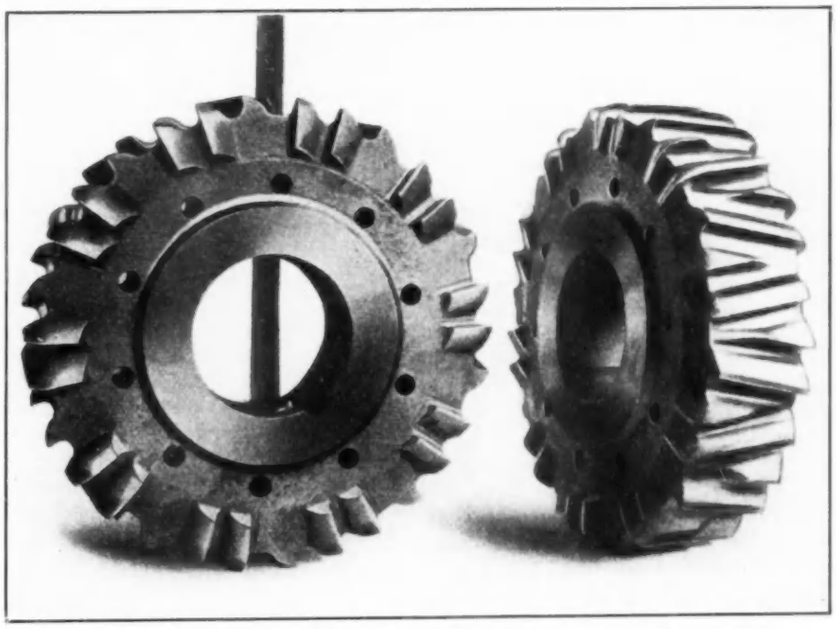
The next step to take is to loosen the fixture and shift it over to the farther hole, strap it down again and you are ready to drill. This will assure the accuracy of both holes. By loosening the thumb-screw *F* the bushing *G* can be taken out and replaced to suit the size of the drill required in the fixture.

Brooklyn, N. Y. A. M. SCHULTHEIS.

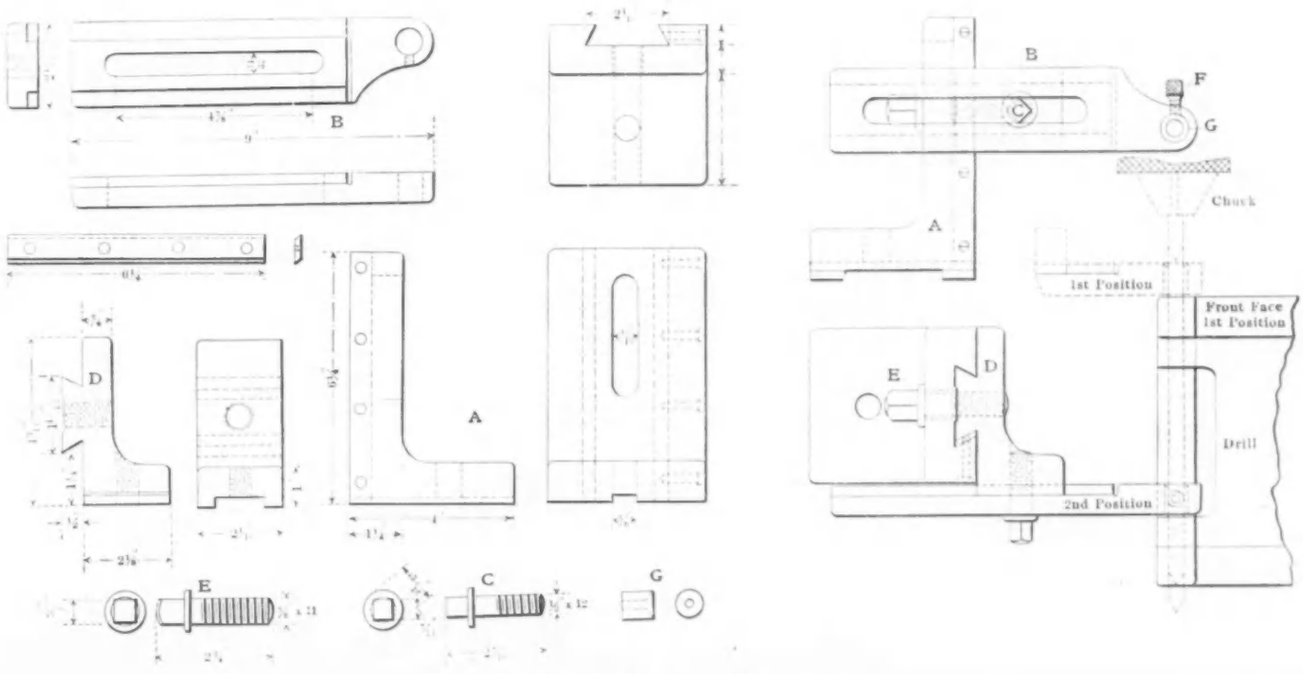
A Novel Cutter

The cut shows a novel pair of milling cutters in use in one of the big Chicago shops.

The cutters are made of blue-chip steel



A NOVEL CUTTER. SIZE, 9½ INCHES DIAMETER BY 2¾ INCHES WIDE



FIXTURE FOR LOCATING JIG-LEAF PIN HOLES

and are 9½ inches in diameter and 2¾ inches in thickness.

The teeth were cut in this manner to break up the chips and give a shearing cut as well as to equalize the cutting strain.

The photograph was taken just after hardening, but they have been in use for some time and have given unusually satisfactory service, being run at a peripheral speed of 65 feet, a table speed of 4 inches per minute, taking a cut ⅛ of an inch in depth and 5½ inches wide, counting the two cutters.

A 25-horsepower motor is used on the milling machine.

Decatur, Ill. ETHAN VIALL.

Counterboring Stands and Tool

The following counterboring stands and tools will be found to be good, accurate and quick tools:

I show two kinds, the principle of each being the same as regards the stops, the only difference being, one has an adjusting screw in the stand, see Fig. 1, and the other an adjustable cutter on the tool, see Fig. 2. The line cuts show clearly the construction of each. *A* is a cast-iron base tapped to receive the adjusting stop screw *B*, and bored from the top for the arbor *C* which is made of cast steel hardened and ground; it has a lapped hole to fit the plain shank of the stop screw *B*; it is, of course, made a light drive fit at *D* in the base casting. Two gaps are provided on opposite sides of the base to enable the operator to reach the stop-screw and lock nut. The counterboring tool is of the ordinary type with the exception that it has a taper hole *E* into which can be fitted various size tits *F*. The shank *G* can be either taper or parallel.

When setting up, a standard U-gage, shown in Fig. 3, is placed on the arbor *G* and the cutting edge of the counterbore is brought to bear on top of this gage. Adjustable stop-screw *B* is then screwed up to touch the end of the tit *F* and locked by means of the nut *G*. The tools are then ready for use. The tools shown in Fig. 2 consist of a cast-iron base *J* bored to receive the hardened steel arbor *K* a light drive fit. The counterboring tool has a center spindle *L* turned and threaded to fit the cutter *M* and locknut *N*. This spindle is hardened and ground.

The setting up is made by bringing the end *P* of the spindle *L* to bear against the top of the arbor *K*, and screwing the cutter *M* to touch the top of the U-gage (shown in Fig. 3); the locknut *N* is then tightened onto the cutter *M*.

London, England. J. THRUMY.

Balancing Large Pulleys

A way of balancing large pulleys that can be done in most shops without making special fixtures is by rolling the pulley on a surface or floor plate if available, or on the platen of a planer or the table of a boring mill, both methods having been used successfully. In one instance an 84-inch heavy pulley was balanced on a boring-mill table of about the same diameter. As it happened to be placed on the table with its heaviest side nearly on top, the table was turned slowly by pulling the belt by hand and rolling the pulley at the same time over the slots in the table until the heavy side was down, which in the majority of cases will come somewhere between the slots in the table, but if it happens to come over a slot the pulley can be worked along a few inches without much trouble.

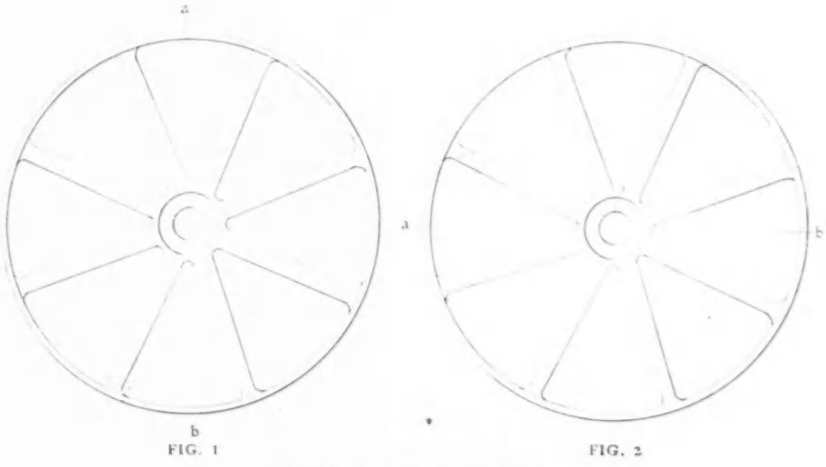


FIG. 1 FIG. 2

BALANCING LARGE PULLEYS

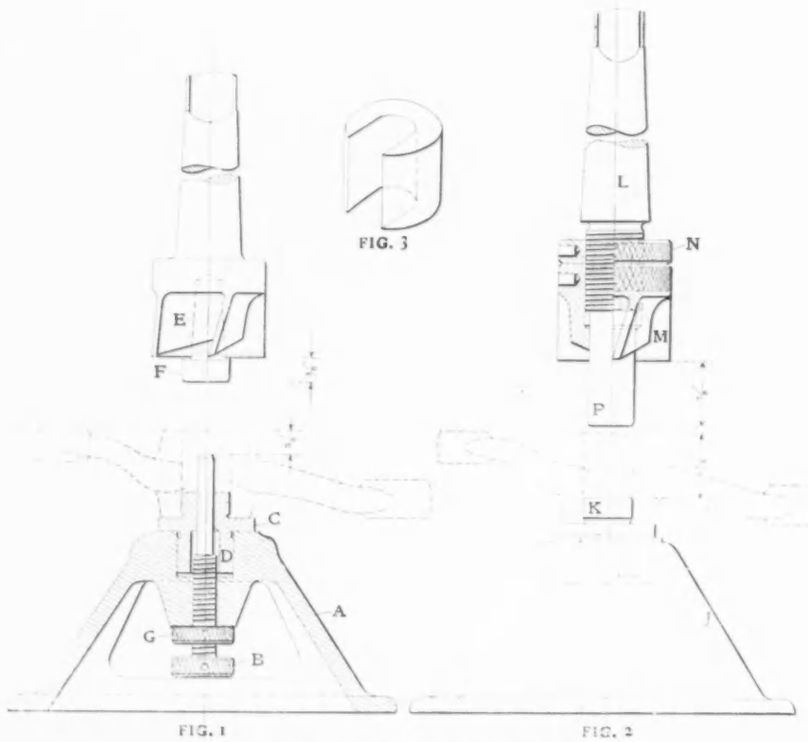


FIG. 1

FIG. 3

FIG. 2

COUNTERBORING STANDS AND TOOLS

The pulley, of course, will come to rest with its heaviest side at the bottom. Then drop a plumb line along its side from the upper part of its rim past the center of its bore and down to that part of the rim which rests on the table and mark the two places on the rim, the upper *a* and the lower *b*, as per Fig. 1. Then roll the pulley as before until the marks *a* and *b* are parallel with the table, as in Fig. 2.

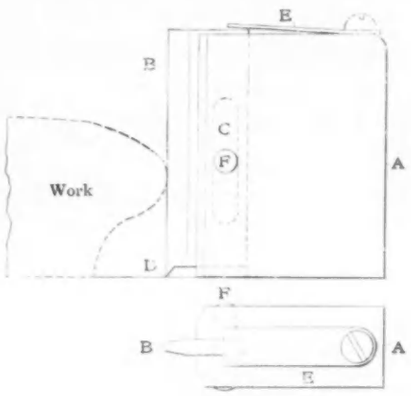
If this leaves the pulley resting over a slot work it along as before, then attach weights to the inside rim of the pulley at point *a* until it balances.

[This will give a fair standing balance but not a running balance, as was shown on page 377.—ED.]

Troy, N. Y. M. H. BALL.

A Scribing Tool

The sketch shows a tool for tracing the outline or edge of work that rises above a level surface and cannot be traced with a scriber in the ordinary way. Much drop-forging work calls for a tool of this kind



A SCRIBING TOOL

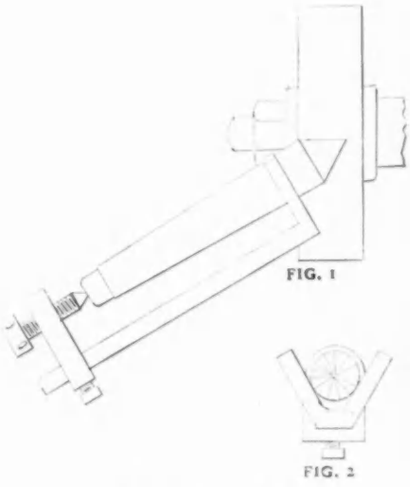
when tracing the outline of the piece on the face of the die.

A, the scriber block, is made from three thicknesses of machine steel riveted together. *B*, the scriber, is made of tool steel hardened; it has a slot *C* and marking point *D*. *E* is a flat steel spring secured to *A* with a screw. *F* is a hardened pin through *A* and slot *C* preventing *B* from falling out. The object of spring *E* is to keep scriber *B* down on the surface to be marked.

Milwaukee, Wis. M. A. HART.

Grinding Lathe Centers

With this tool a man can, with very little skill, grind a lathe center perfectly



GRINDING LATHE CENTERS

true on a common emery wheel in less time than he can set up the ordinary grinding rig on his lathe. Fig. 1 shows the position of holding the center to the wheel when giving the center the last finish. If the center is in bad shape, by lowering the left hand the operator can make the wheel cut very fast. It does not make any difference how much the center is out of true, the high speed at which it will run generates a true center.

Harrisburg, Penn. WALLACE.

A Box Tool for the Automatic

The box tool, shown in Figs. 1 and 2, was designed for a special piece of work, but has been successfully used on various jobs within the range of the Cleveland screw machine it was constructed for. As will be noticed in Fig. 1, the rollers are ahead of the cutters which, I think, gives the best results in working rolled stock, and where the pieces are to be finished on the grinder.

On the job this tool is mostly used for, it serves as a steady rest while taking its cut, for a wide forming tool on the back of the cross-slide, which accounts for its being made so rigid in most parts. The front of the cross-slide is provided with a combination undercut, recessing and cut-off tools, the work being steadied with a rest which is held in the third hole of the turret.

This box tool has a range from 1¼ inches, which is the largest stock the machine will take, to ⅜ inch diameter; but it will turn smaller by forging the point of the tool down. The tool shown is of ½-inch square high-speed steel, but in taking heavy cuts, it would be advisable to use ⅝- or ¾-inch steel.

The tool post and ring screw, together with a 16-pitch thread, and by having 125 equal divisions marked on the periphery of the ring, as in Fig. 2, the adjustment of the ring one space raises or lowers it 0.0005 inch, but makes 0.001 inch difference on the cut taken. In making another tool like this, I think I should make

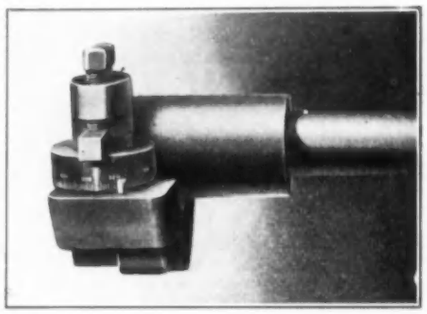


FIG. 2. BOX TOOL FOR THE AUTOMATIC

the tool post a shrink fit in the body, instead of screwing it in as indicated.

Davenport, Iowa. H. C.

An Acid-resisting Cement

An investigator has discovered that a mixture of the following ingredients forms an acid-resisting cement for tanks, floors, etc.: Silicate of soda, 6 parts (water glass); glycerin, 1 part; red lead, 3½ parts; fine cinders, 10 parts.

The silicate of soda and glycerin are mixed and then the red lead and cinders added to make a mass resembling putty. This is used for the cement. It soon sets or hardens, and when heated to the temperature of boiling water, unites with brick or portland cement to form a strong joint.—*The Brass World.*

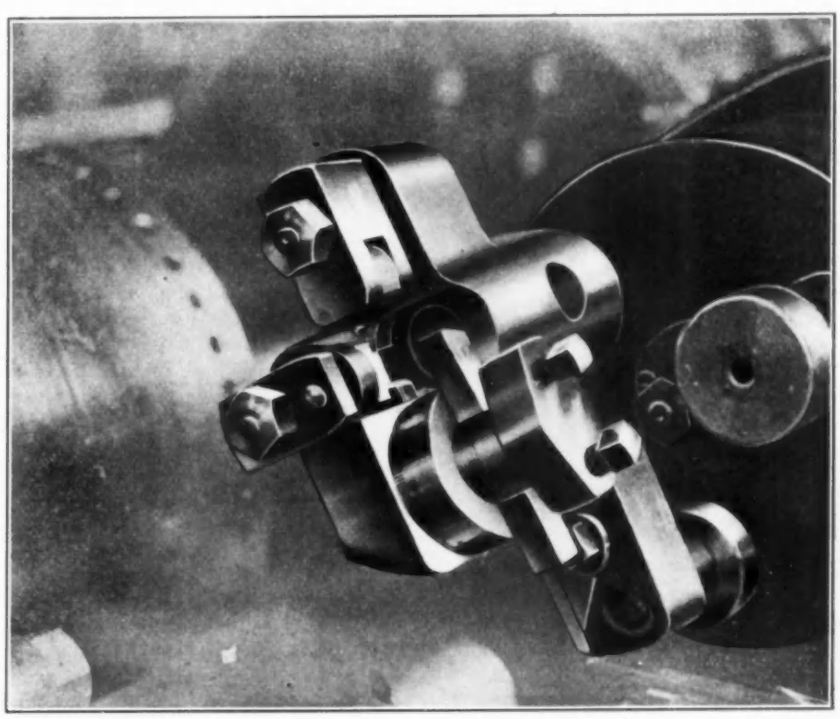


FIG. 1. BOX TOOL FOR THE AUTOMATIC

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None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

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Salaries of Professors in Engineering Schools

A friendly controversy is continually waged between the engineer or practical man, and the technical educator or, as he is frequently referred to, theoretical man. If we stop to consider the relative positions of the contestants and admit that living up to high ideals of service is worthy of our commendation, the professor has the best of it. We do not doubt but that there are many professors who could command salaries many times greater than those which they are now receiving, should they take up engineering work. And if the engineer has really at heart the practicalization of engineering education, let him give up anywhere from one-half to nine-tenths of his present income and fill a professor's chair.

Money wise, the professor in a technical school is far worse paid than his brother in commercial lines. There are, of course, offseting features, such as long vacations, opportunities for research work, social position, social advantages, and the like. From the report of a recent study made by the Carnegie Foundation for the Advancement of Teaching, we abstract the following statistics in regard to the average professor's salary paid by several of the more prominent engineering schools of this country:

Institution.	Average Salary of Professor.
Cornell University	$3135
University of Illinois	2851
Massachusetts Institute of Technology	3192
Armour Institute of Technology	2150
Stevens Institute of Technology	3200
Worcester Polytechnic Institute	2369
Case School of Applied Science	2861
Rensselær Polytechnic Institute	3300
Rose Polytechnic Institute	2250

Electrically Driven Tools

There is one phase in regard to the introduction of electrically-driven tools into the small or average shop which, if overlooked, may be regretted. While electric motors have become extremely reliable, they are, in common with all classes of machinery, prone to some ills of derangement, and as their diseases are entirely different from those with which the average mechanic is at all familiar, he is usually left in a very hopeless position when the motor goes wrong.

For this reason some of the large tool builders hesitate to recommend electrically-driven tools for any shop which does not employ a skilled electrician at all times, so that any ordinary derangement can be taken care of at once. It does not take many hours' delay caused by a motor being disabled and the machine out of commission, to offset a considerable saving in output, and it also induces a feeling of insecurity which is far from pleasing to any shop management.

One of the large machine-tool shops in question uses electrically-driven tools exclusively, and believes it is the only way to drive machines when you have electrical equipment enough to warrant the employment of the electrician. Among other appliances in this shop are two large planers controlled entirely by electrical apparatus in such a way that there are gradual changes of speed of the table during reversal and going to high speed on the return stroke, all of which involves somewhat complicated electrical apparatus. In this shop no trouble whatever has been experienced from this source, because at the slightest indication of trouble the electrician was summoned and everything kept in first-class order at all times. But in the average shop such a machine would very likely be out of commission half of the time, and the entire apparatus would probably be condemned as a complete failure.

Electrical driving of machine tools has come to stay until something better is devised, but it is advisable to consider all phases of the question before going into it in a small way, as there are chances of being disappointed in some of the ways mentioned.

Wages in Europe

The question of wage rate in European countries is one that is often mentioned, but at the same time very few facts are brought forward to show that European labor is paid at a very low rate. A recent article in the London Daily *News* compares the family income of the wage-earning classes of Germany and Great Britain. The statistics are drawn from income-tax records. Those for Germany, however, are taken for convenience from the State of Prussia alone and are considered typical for the German Empire. Income-tax assessments begin in Prussia at $225 a year or $4.28 per week. British income taxation begins with incomes of $800 a year or $15.30 per week. In 1907, an income tax was not assessed on 21,000,000 persons in Prussia, out of a total population of 38,000,000. In other words, 21,000,000 persons of the population of Prussia out of a total of 38,000,000, or something over one-half, live in families, none of whose members earn as much as $4.28 per week. Turning to Britain we have 1,000,000 families that pay an income tax, or figuring five persons in a family, a total of 5,000,000 persons who are subject to this tax. The gross yearly income of the other 39,000,000 is estimated at $4,500,000,000. If we divide these persons into families of five, the average weekly family income is $11.10. This quantity is not in direct comparison with the $4.28 given above for a weekly Germany income; however, the quantities tend to give us an idea of German and British wage rates.

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make It Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

Attachments for the LeBlond Milling Machine

The R. K. LeBlond Machine Tool Company, Cincinnati, O., has recently brought out a number of new attachments for their milling machines, which are illustrated herewith. Figs. 1 to 4 show various applications of their geared hobbing attachment, which is driven directly from the milling-machine spindle through the gearing and splined shaft shown. Fig. 1 shows the hobbing of a large worm wheel 15⅛ inches in diameter, having 120 teeth of 0.39 inch circular pitch. This is being hobbed without previous notching or gashing. Fig. 2 is a coarse pitch worm or spiral gear having 26 teeth, six pitch, 2⅝ inches in diameter and being cut to run with a quadruple thread worm. The work is fed into the hob by power and is automatically tripped at the proper depth. These gears were hobbed complete in 12 minutes each. Fig. 3 shows the hobbing of a long spur pinion, six pitch, 24 teeth and 14 inches long. For hobbing spur gears it is necessary to use this attachment on a universal milling machine, so as to secure the proper angle of the work by the swiveling of the table to correspond with the angle of the spiral on the hob. In Fig. 4 is the hobbing of a spur gear of 102 teeth, eight pitch. The drive in this case is through the worm and worm wheel of the dividing head and gears up to 16 inches of diameter can be cut in this way.

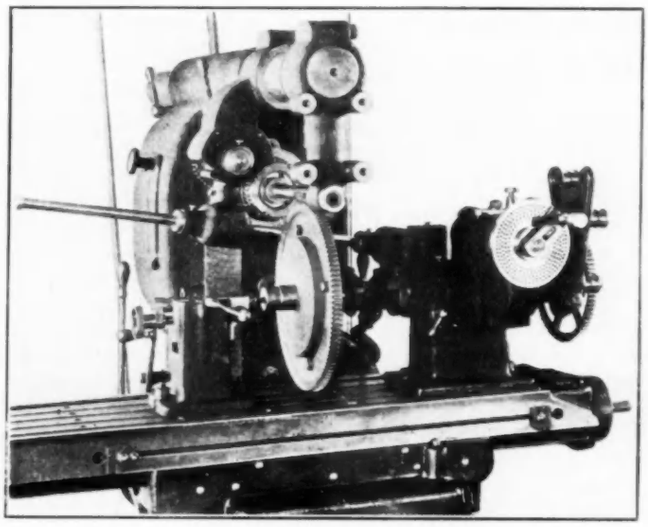


FIG. 1. HOBBING A LARGE WORM

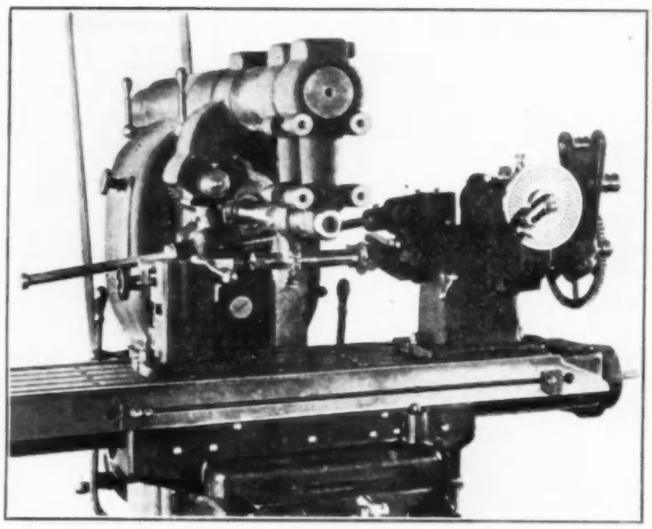


FIG. 2. GASHING A SMALL WORM

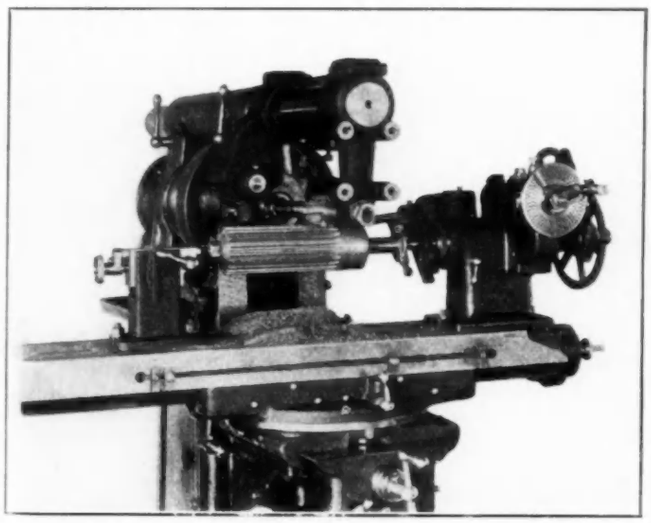


FIG. 3. HOBBING A LONG PINION

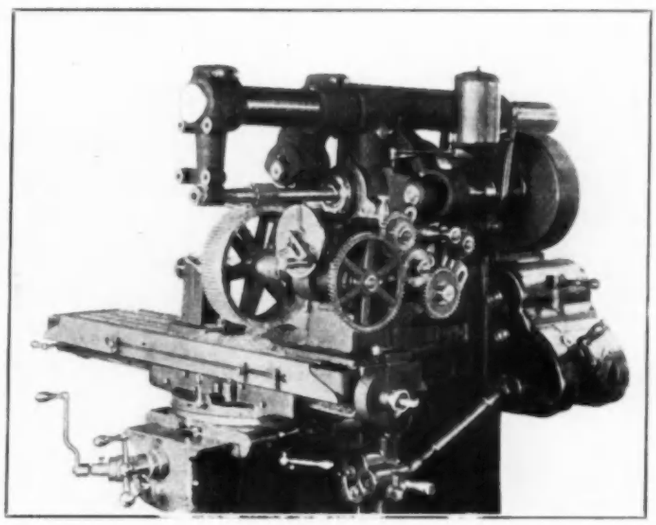


FIG. 4. HOBBING TWO SPUR GEARS

Fig. 5 shows a universal spiral gear-cutting attachment for use on the plain milling machine. The cutter head can be turned completely around so that it can cut racks, mill the thread of screws and can be used on the universal milling machine for cutting gears of any angle such

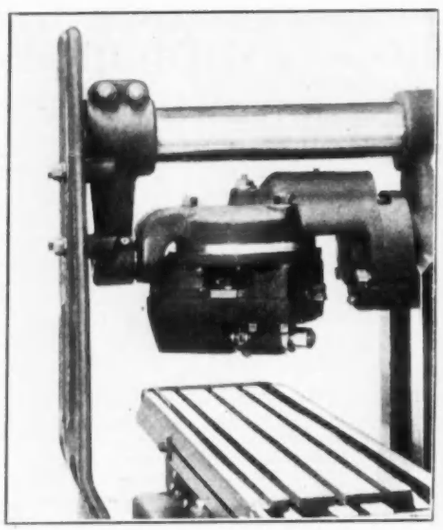


FIG. 5. UNIVERSAL RACK CUTTER

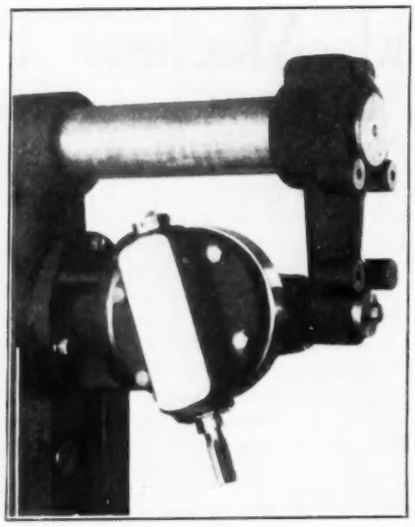


FIG. 6. UNIVERSAL ATTACHMENT

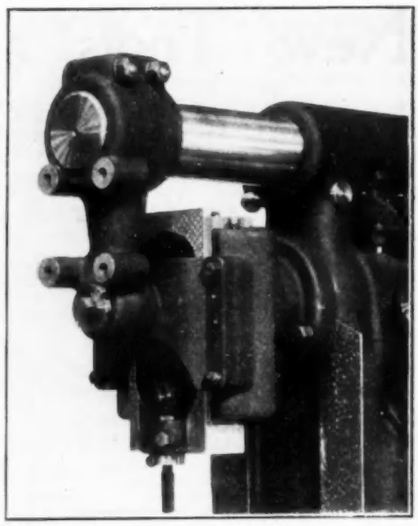


FIG. 7. THE SLOTTER

as those used in gas-engine work, which cannot be cut on the universal machine owing to the limited swivel of the table. This attachment is bolted to the column with the outer end supported by the overarm of the machine. It is driven from a clutch gear on the spindle through a series of spur and bevel gears to the cutter spindle. The cutter spindle itself is carried in a slide having lateral adjustment. The cutter is carried between two bearings which form a rigid support and the outer bearing is in the removable head to allow the cutter being easily inserted or removed. In setting the cutter, the main slide is first adjusted until the center line on the cutter coincides with the swivel axis of the attachment. This is done by first setting the center line of the cutter to coincide with the line on the attachment and then adjusting the cutter to suit. After the cutter is once set the attachment can be swiveled to any angle without disturbing the correct relation of the center of the work and cutter.

Fig. 6 is a universal milling attachment which allows the cutter spindle to be swiveled to any position in a horizontal or vertical plane. This attachment is also bolted to the column of the machine and the outer end supported by the overarm. The spindle is driven by a clutch on the main spindle through two pairs of mitre gears. The front bearing is taper and is hardened and ground while the rear bearing is straight and is adjusted by drawing in a taper bushing.

Fig. 7 is a slotting attachment which can be swiveled in any direction around a horizontal axis. It is driven from the clutch in the main spindle and has an adjustable stroke. The tool holder is graduated and can be swiveled in its bearing so that the cutting edge can be set without disturbing the adjustment.

In Fig. 8 is a rack-spacing attachment to be used in connection with the rack-cutting attachment. This consists of the necessary mechanism for spacing the table when cutting racks without the use of the graduated collar on the feed screw. It is bolted to the table and has the quadrant and necessary change gears to connect the feed screw with the locking disk. The locking disk is made in two sections and can be reversed. One side contains two notches, the other side one notch, for spacing full and half revolutions. Change gears are furnished for spacing all diametral pitches from 3 to 6 by half pitches, from 6 to 16 by whole pitches and from 16 to 32 by two pitches or circular pitches from 1/16 to ½ inch by thirty-seconds and ½ to 1 inch by sixteenths, making 15 change gears in all.

Fig. 9 is a vertical index head, which has been found very rapid for cutting clutches, milling the heads of screws and similar work. The divisions are made by vertically notches plates and can be handled very rapidly. The small lever shown at the side of the spindle locks it securely in position after the division has been changed. The spindle is taper, the front flange being extended to protect the index plate from chips. The spindle has a No. 11 Brown & Sharpe taper hole.

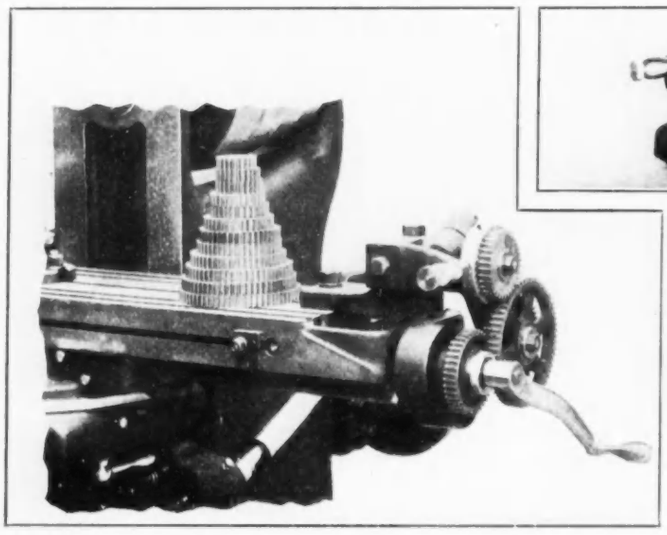


FIG. 8. RACK-CUTTING INDEX GEARS

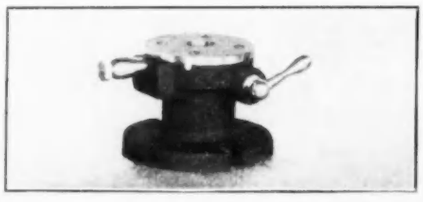


FIG. 9. VERTICAL CHUCK

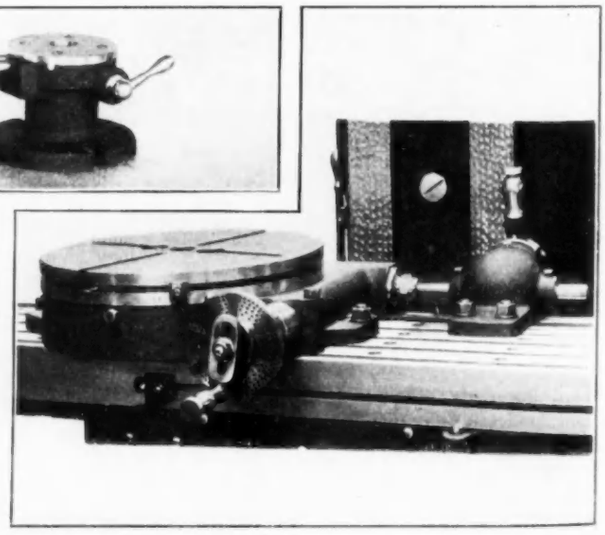


FIG. 10. CIRCULAR TABLE

Fig. 10 shows a circular milling attachment in which compactness is one of the features of the design, the hight being kept as low as possible in order to give the maximum distance for work when used in connection with the vertical or other attachment. The worm-wheel has 120 teeth and is driven by a worm cut on the shaft itself. The worm is carried in an eccentric sleeve so that it can be adjusted into the wheel, or can be thrown entirely out of gear to allow the table to be turned by hand. The end thrust of the worm is taken by ball bearings and means are provided for attaching power feed when desired. This does not interfere with the regular feed of the table as it is driven by an independent shaft from the feed box of the machine. It can be operated in either direction and has dogs, which automatically trip the feed at any point. It can be arranged for spacing by removing the hand wheel and substituting index plates and sector. In this way accurate dividing can be done and the same number of divisions obtained as on the standard dividing head. The table is bored to receive a taper plug for use in gear cutting.

Plain Manufacturing Engine Lathes

This has been designed especially for plain manufacturing, the main point kept in view being stiffness and cutting power. The back-gear ratio is 10 to 1, and the cone is designed for a 2½-inch belt. The quick-change gear device has been especially designed for feeds and not for threads, as these are not nearly so important in the average shop work. The feed-changing device is very simple and is shown in detail in Fig. 2.

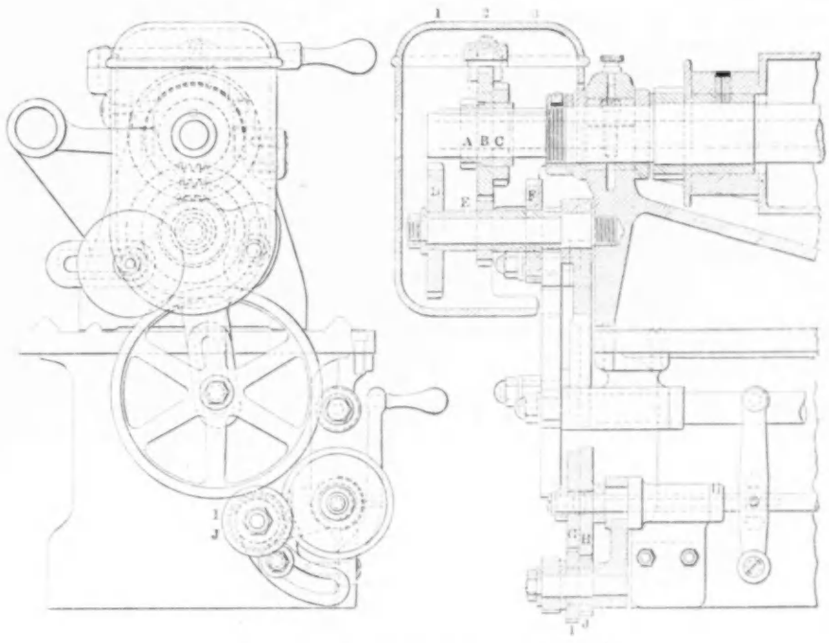


FIG. 2. DETAILS OF HEAD AND CHANGE GEARS

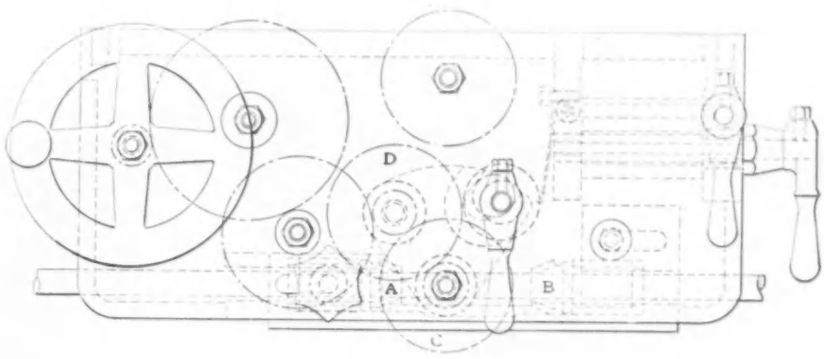


FIG. 3. LATHE-CARRIAGE DETAILS

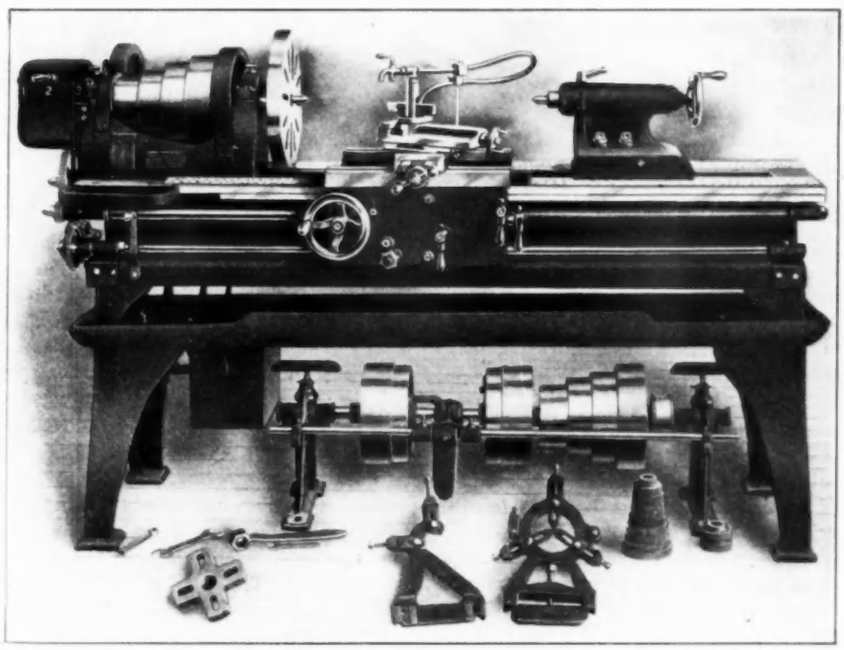


FIG. 1. MANUFACTURING ENGINE LATHE

Three gears, *A*, *B* and *C* are mounted on an extension of the lathe spindle and are free to slide on it, being driven by the key shown. These gears are controlled by the lever at the end of the lathe head and can easily be moved into either of the three positions shown. In this way they engage either gears *D*, *E* or *F* at will and give three feeds in this manner. These three changes can be doubled by moving the handle shown near the end of the bed, which controls a sliding key in the gears *G* and *H*, so that six different feeds are obtained without changing any gears, and these are sufficient for nine-tenths of the work the lathe will be called upon to perform.

Fig. 3 shows the details of the gearing in the apron and it will be seen that there are neither worms nor friction used in this design. Power is transmitted from the feed by the small bevel pinions *A* and *B*, either one or the other being used according to the direction of feed desired. The position of these is controlled by the small star wheel, which locks either one

or the other into mesh, and disengages both when threads are being cut. For the longitudinal feed it is easy to trace the gear train through *A*, *B* and *D* up toward the hand wheel at the left. For the power cross-feed the central handle is turned up so as to throw the eccentric which controls the sector carrying the gear *D*, out of the longitudinal train and into mesh with the cross-feed gear above. This effectually prevents both feeds being engaged at the same time and makes them both positive. The lead screw is entirely independent of the feeding mechanism and the half nuts are controlled by the handles shown at the right of the carriage. The gearing is so designed that one turn of the hand wheel moves the carriage one inch, which is very convenient in catching threads.

This lathe can be furnished with a taper and relieving attachments, oil pan and pump if desired. It is built by the Walcott & Wood Machine Tool Company, Jackson, Mich.

Improvement in the Noyes Vertical T-square

The Noyes vertical T-square has been improved in several of its details since it was illustrated in our columns at page 430, the first part of the present volume. This seems to be a very convenient and substantial instrument for the drawing room, and is now being made by the Emmert Manufacturing Company, Waynesboro, Penn.

Dill Variable Speed Drive

As can be seen in Fig. 1 this drive consists of a main or power shaft *A*, carrying a series of thin disks, and intermediate shafts with two sets of disks, *B* and *C*, and a third or transmitting shaft *D*, with a fourth set of disks similar to the first set on *A*. The power shaft *A* runs at a constant speed from any source, and the speed delivered from the shaft *D* depends upon the position of the intermediate shaft with relation to *A* and *D*. This shaft can be moved either toward *A* or *D* by the lever on the outside of the gate, moving it toward *A* decreasing the speed of *D* and vice versa. The disks on *A* and *D* are loosely mounted on the squared portion of the shaft so as to be free to move endwise as much as necessary, while the disks *B* and *C*, also loose on the shaft, are forced together by the coil spring in the center, the tension of this being adjustable to prevent slipping and secure the necessary power.

One set of the engaging disks has perfectly straight sides, while the other set is slightly tapered, so that there is only a point of contact between the tapered side of the driving disk and the flat side of the driven disk, as in *A* and *D*. As the intermediate shaft is moved toward *A*, the disks at *D* are forced apart to a small extent by the taper of one set of disks, which insure perfect contact, and the variation is taken up by the coil spring. This has the effect of reducing the working diameter of the driving disk *A*, and of also increasing the working diameter of the disk on *D*, so that slower speed results. Throwing the intermediate shaft in the opposite direction increases the speed in a like manner and gives any intermediate speed between maximum and minimum that may be desired.

Constant horsepower is obtained in this way, as the tension of the spring varies with the feed, due to the difference in thickness of the tapered disk, and makes the spring stronger when the speed is the slowest. The power transmitted depends entirely upon the number of disks and to 10 horsepower, with speed ratios of their diameter, and they have been built up 30 to 1.

Fig. 2 shows the appearance of the device from the outside and can be used either on the floor or on the ceiling in connection with a countershaft. The five horsepower drive of this type is 23 inches long, 13 inches wide overall and 9 inches high. The disks are 4 inches in diameter and 3/64 of an inch thick, with the speed of the driven shaft 400 revolutions per minute. It is designed to be entirely inclosed and runs in an oil bath.

Fig. 3 shows a suggestion for its application to an engine lathe. The speed changes are secured by the rod running up to the countershaft, and this can be controlled by the lever at the back of the lathe, or it can be arranged to be controlled automatically by the position of the lathe tool, which depends upon the diameter being turned. In this way it

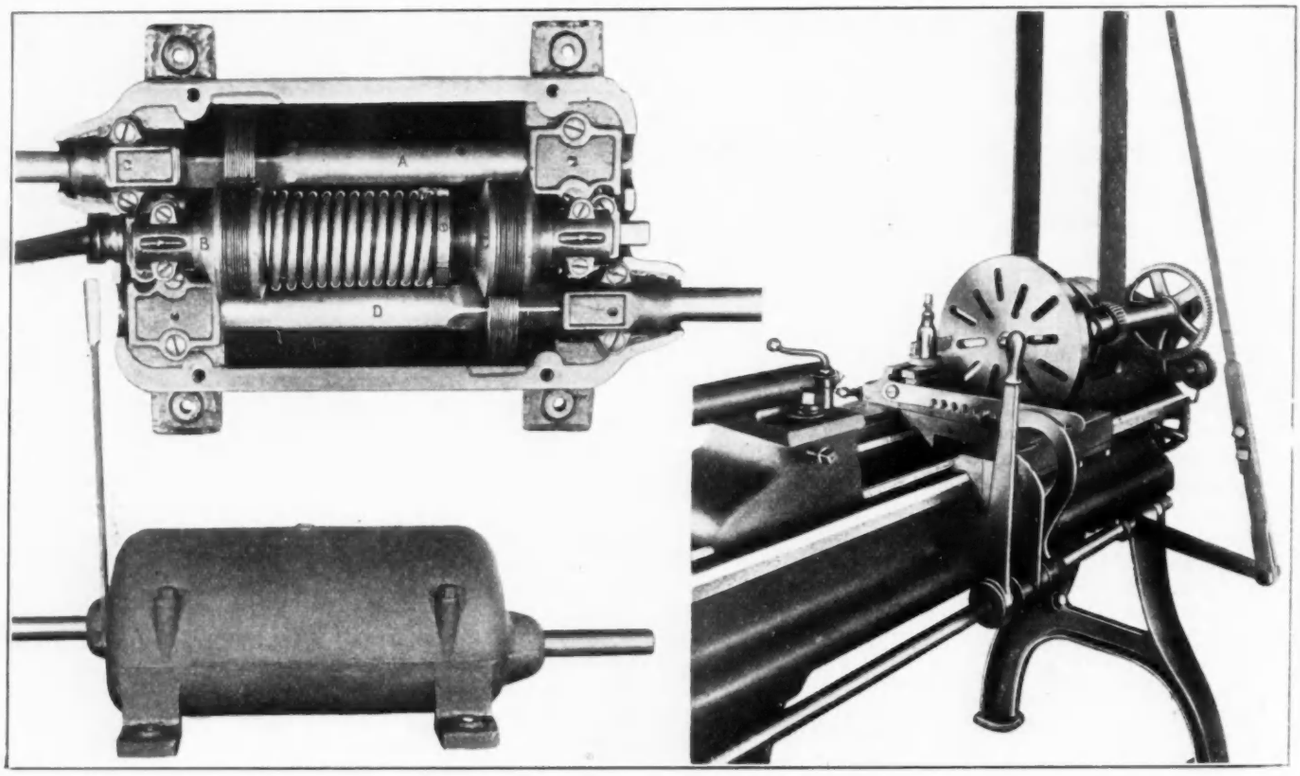


FIG. 1. THE INSIDE OF THE DRIVE
FIG. 2. AS IT APPEARS CASED UP

FIG. 3. AN APPLICATION TO AN ENGINE LATHE FOR VARYING SPEED AUTOMATICALLY

automatically increases the speed on small diameters, and by connecting the curved lever with any of the notches on the bar fastened to the tool block any rate of speed may be secured, which will be automatically varied according to the diameter being turned, and a constant cutting speed maintained. This is now ready for the market and is being manufactured by the T. C. Dill Machine Company, Philadelphia, Pa.

Fig. 4 shows the device built into a lathe head which is very compact and free from complication. The illustration shows the arrangement of the taper and straight disks and the way in which the speed is varied by swinging the intermediate shaft into varying relations with the others. In this case it is done automatically as in Fig. 3, but can be arranged to suit.

Engine Lathe with Geared Feed

This is a very substantial 16-inch engine lathe having a three-step cone for a 3¼-inch belt and being provided with double back gears. It is built by the Cincinnati Lathe and Tool Company, Cincinnati, Ohio, and has a new positive-geared feed.

This replaces the belt feed with a positive-geared device which gives six feeds ranging from 16 to 100 per inch by simply moving a lever. Fig. 2 shows how this is done. Shaft *A* drives worm *D* through *B* and *C*, and this meshes into worm gears *E*, *F*, or *G*, according to the vertical position of the lever *H*, the worm gears being pushed under the worm by the fork *I*. This gives three changes, and the position of gears *L* and *M* with *J* and *K*

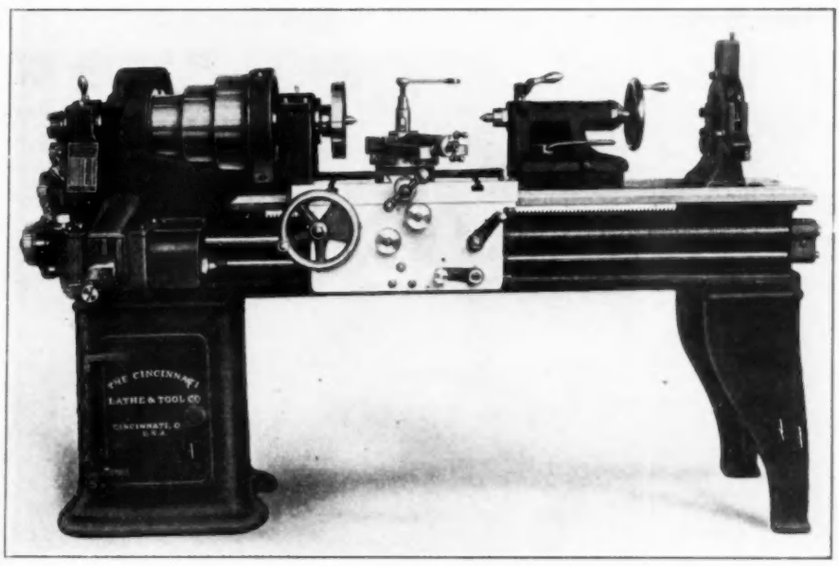


FIG. 1. ENGINE LATHE WITH GEARED FEED

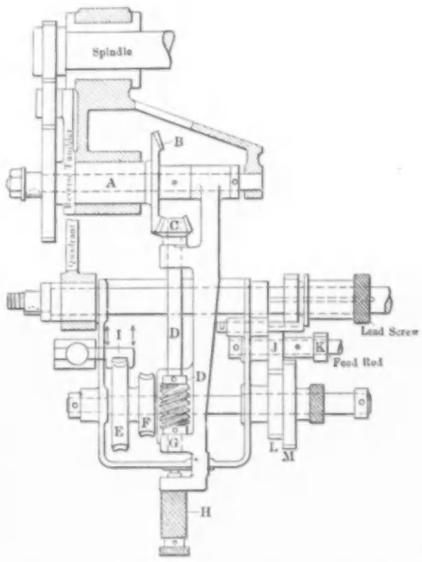


FIG. 2. THE POSITIVE FEED MECHANISM

gives two other feeds for each position of handle *H*. This makes a very compact arrangement and one that is easily handled.

All gears are made from bar steel, and those operating loosely on the shaft are bushed with bronze, all being designed to stand any cut the main driving belt will

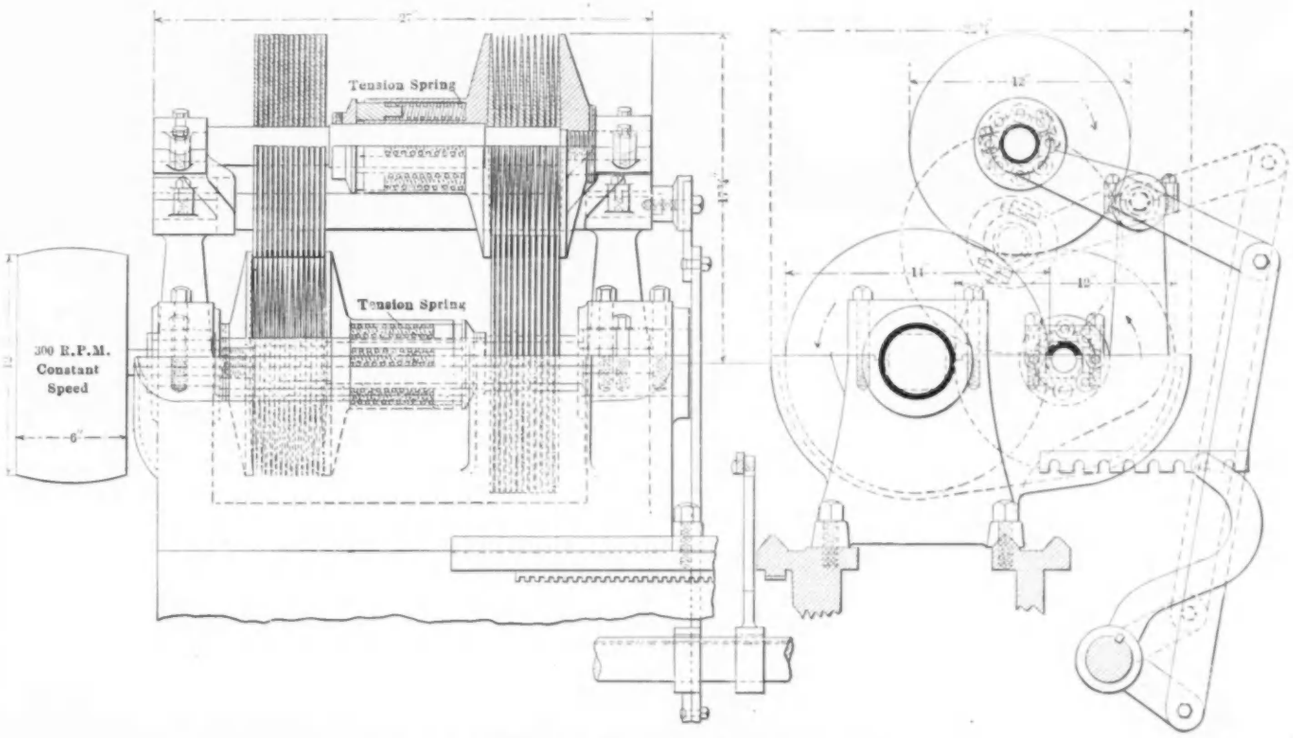


FIG. 4. THE DILL DRIVE BUILT INTO A LATHE HEAD

pull. The back-gear quills are of steel and have both ends bushed with bronze.

The lathe swings over the bed 16½ inches, 10¼ inches over the carriage. The front spindle bearing is 2¾ by 5¼, and there is a 1¼ hole in the spindle. The taper attachment travels with the carriage and permits tapers of from zero to 4 inches to the foot and 12 inches long with one setting. This attachment can be applied to one of these lathes at any time after it has been installed. All necessary fixtures go with the lathe, including draw-in attachments, oil pans, turret on carriage and any other fixtures that may be desired.

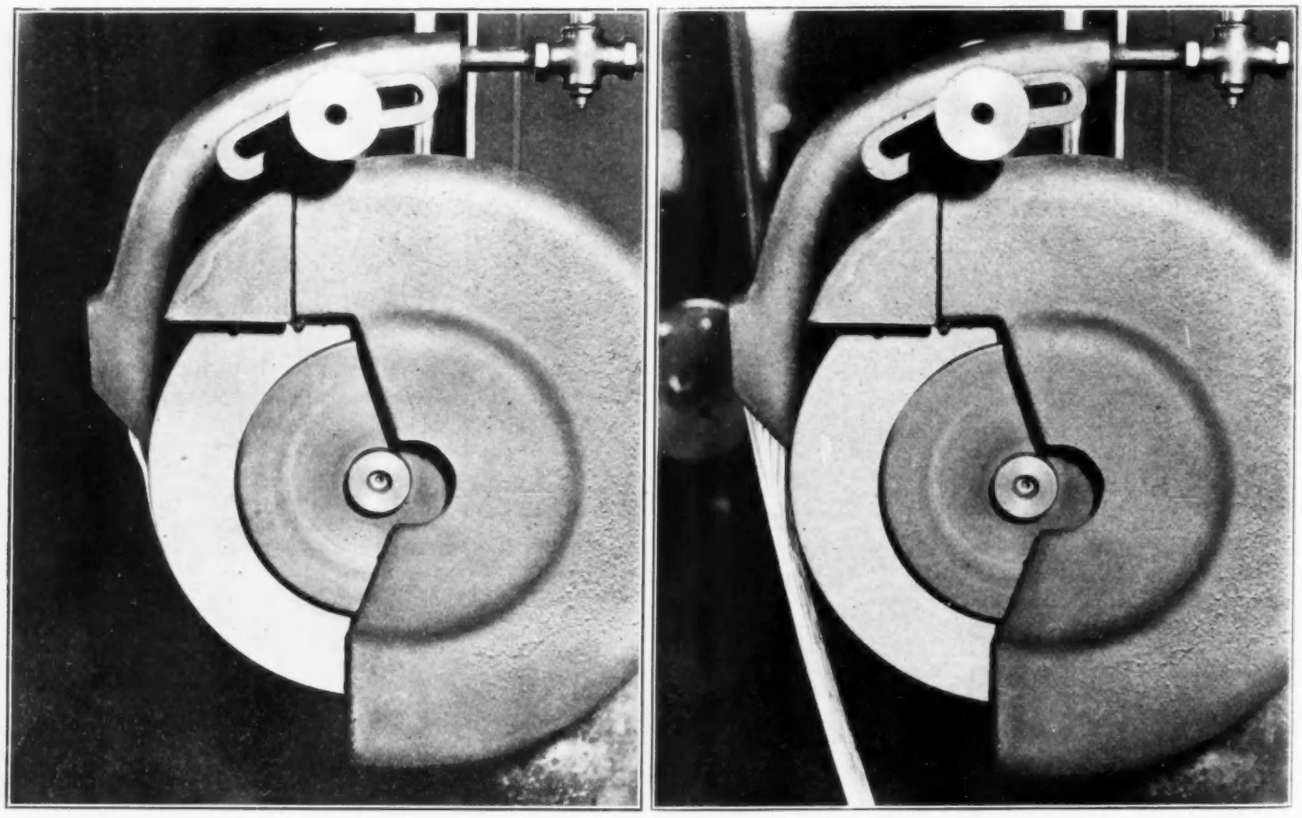
The first American glass-bottle manufacturing machine in operation in Europe has just been exhibited before a number of invited guests at Gerresheim, near Dusseldorf, by a firm which purchased the right of making bottles by this machine for 12,000,000 marks ($2,856,000) from the American patentees. Hitherto the firm had used the machines which could only produce 1500 to 2000 bottles per day, whereas the later American machine turns out 15,000 bottles per diem.

The first electric ferryboat in Germany has just been launched at Duisburg. It has twin screws, which are propelled by an accumulating current from two electric motors of 50 horsepower capacity. The boat can carry 645 passengers, besides horses, automobiles, and vehicles.

An Emery Wheel Nozzle That Does Not Splash

Few of us have ever given any attention to the nozzle which supplies water to the emery wheel except when it gives us a shower bath or splashes water all over the machine. Water guards of various kinds have been devised to keep the water within bounds and prevent its being spread all over the floor.

But a nozzle has been designed which is free from these disagreeable habits and which is exciting much comment among those who have seen it. It has been devised by John Bath of the Bath Grinder Company, Fitchburg, Mass., and is being applied to all its machines.



NON-SPLASHING NOZZLE FOR EMERY WHEELS

The two illustrations show the action of the water as it comes out of the nozzle under extremes of condition, one with full head, the other with a very small stream, but in neither case is there any sign of splashing. In fact, there is a total absence of the water being blown away by the air or windage from the wheel as is usually the case. Stranger yet, note how the small stream actually curves back toward the wheel instead of being blown away from it. Many theories have been advanced for this action by the many different observers, but few have agreed as to the cause. The main point is that the water does not splash, as that is the most interesting to the user. It all goes directly on to the work and then some of it follows the wheel back into the hood, all finally running quietly down to the tank where it belongs.

Mr. Bath will be glad to have any of our readers tell him why it doesn't splash.

Machine for Compressing Refuse

There is an interesting plant in New Bedford for disposing, or rather making use of the garbage or swill that is collected by the city scavengers. This is dumped into a hopper and feeds down on to a heavy screw conveyer fitted in a long cylinder. The bottom of the cylinder is made up of perforated composition plates so that the liquid can all be squeezed out in the passage. A contracted opening at the end serves to compress the solid portion to about one-fourth its original bulk and delivers it in such solid shape that it can be readily handled for fertilizing purposes.

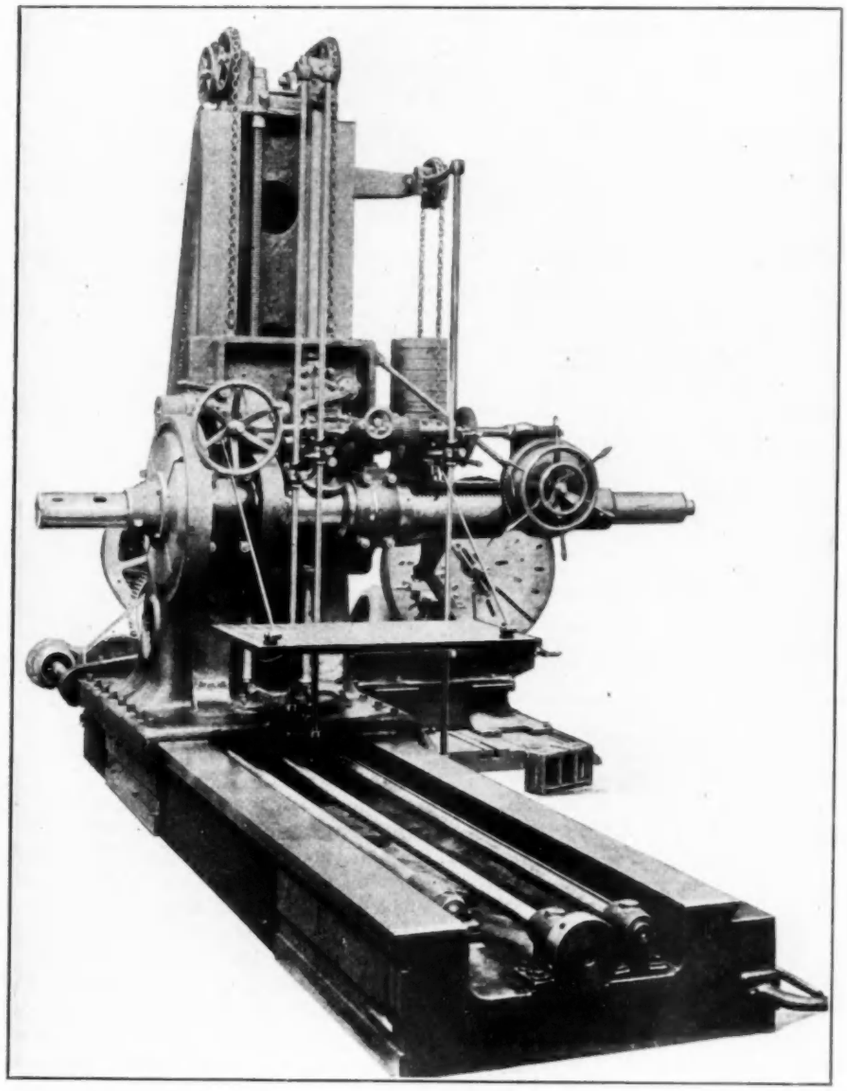
This was built by the Wyman & Moore Company, of South Boston, Mass., and an interesting feature is a steam-actuated gate valve with a knife edge like a guillotine, which can shut off the flow at will, and if an old shoe or tin can happens to be in the way, will shear it in two as though nothing was there. In testing these machines they had to bring in a large amount of swill from New Bedford, as Boston garbage is not allowed to contain any foreign matter like old shirts or shoes. The machines are said to be working very nicely, and to dispose of a very annoying problem.

A Large Norwegian Horizontal Boring Machine

The accompanying illustration shows a large horizontal boring machine recently built by the firm of Brodrene Sundt, of Christiana, Norway. The column has a horizontal movement on its bed of 158 inches, while the saddle carrying the spindle has a maximum vertical travel of 72 inches, and at its highest point, the center of the spindle, is 105 inches from the bed plate. The spindle is 7.2 inches in diameter and has a traverse of 60 inches. The bed is 60 inches wide and 20 inches deep, while the length of the base of the vertical column is 75 inches.

Sixteen spindle speeds are provided, ranging from 1.5 to 200 revolutions per minute. There are eight feeds for the saddle and column when used for milling, and eight boring and drilling feeds, all feeds being reversible at will. Vertical columns have a quick-return movement of 23½ inches per minute.

All feeds, reversing and quick-return movements of the column, the saddle and spindle are controlled from the operator's platform, shown in front of the spindle saddle. This machine is used in connection with a large bed plate of 190x220 inches, and the weight of the machine without the bed plate is 60,000 pounds. Graduations are provided on both the vertical column and the outboard bearing for ease and rapidity of setting up the machine.



LARGE HORIZONTAL MILLING AND BORING MACHINE MADE IN NORWAY

The Belgian government will this autumn order for equipment of its railroads 5000 freight cars, 700 passenger cars, and 220 locomotives. German papers in reporting this news item say that German works last year obtained a large share of similar contracts then given out, but must expect to meet sharper competition from car and locomotive works in other countries.

Press Fixture for Drifting Hexagonal Holes

By F. W. G. Grant

The fixture illustrated herewith was devised for drifting 7/32-inch hexagon holes in the ends of a number of 5/16-inch No. 24 headless set-screws.

The blanks were partly pointed, threaded, turned end for end, and drilled in the screw machine for a depth sufficient to insure against bottoming the drift which enters 3/16 inch.

The base-plate casting *A* is arranged for bolting down to the bolster plate, and is provided with an extension to carry the pivot post *B* of the oscillating plate *C*, Fig. 1.

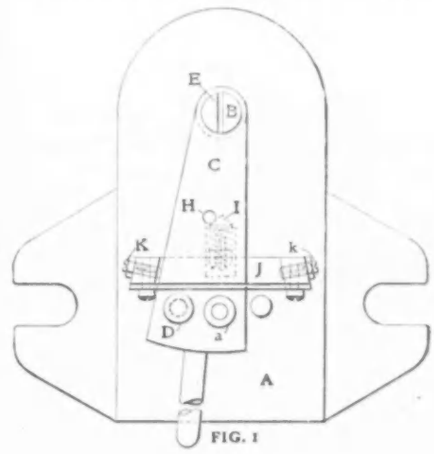


FIG. 1

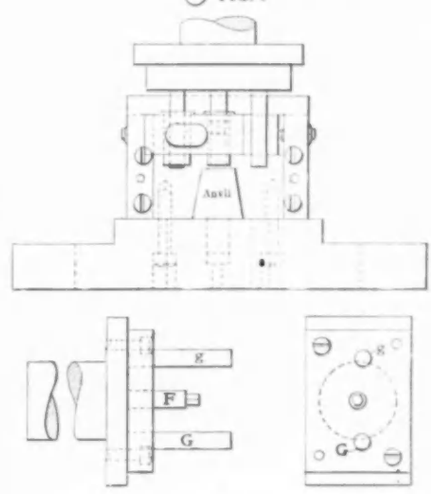


FIG. 2

JIG FOR DRIFTING HEXAGONAL HOLES

Two bushings *D d* in the oscillating plate *C*, are arranged at an equal radial distance from the pivoting point *E*, and at an angular distance from each other equal to the angular distance between the forming drift *F* and the clearing drifts *G g* (see Fig. 2).

A downwardly depending pin *H*, attached to the plate *C* in connection with a pointed spring-pressed plunger *I*, mounted in the supporting bar *J*, provides a means of insuring the contact of the oscillating plate *C* with one or the other

of the adjusting screws *K k* as the plate is swung from side to side.

The punch stock, Fig. 2, carries three drifts; the center one has a hexagon-forming end, above which is a parallel portion arranged to fit the bushings *D d*; the other two are pieces of 5/16-inch drill rod long enough to go clear through the bushings when in their adjusted positions.

The fixture is set up by entering two of the drifts in the bushings and then bolting the piece to the machine as if it were a punch and die.

The operation is as follows: After adjusting for hight by means of a set piece of 5/16-inch drill rod, one of the set-screws is put into the bush under the forming drift and the press tripped, after which the oscillating plate is shifted to the other side and another screw placed in the other bush and the press tripped and drives out the first, which falls through again; this cycle forms the second screw one of the holes provided in the base plate *A*, and into a box under the press.

The bushings *D d* are slightly tapering in the hole, which increases in size toward the bottom. The drift is slightly tapered also, but in the opposite direction, to insure the stripping of the screws from the drift.

Card System for the Pattern Shop

By C. J. Fry

Of the many places where a system is welcomed as an expert helper, the pattern shop is a most important one. To be a helper, it must be a system, simple and complete, and not a burden to the man who has to keep it up. There have been many pattern systems developed which contain some good points, but they are too complex for a small shop where the care falls to the pattern foreman. Again, a system which will work nicely in one shop will fail utterly in another, as it deals with a different class of product.

The following system has proved to be very simple, yet very efficient in the shop for which it was developed. There may be a few new ideas in it and some readers will doubtless notice some familiar ones, as the father of it made use of the good ideas he had met in various other shops, with enough changes to suit the following conditions: A small shop manufacturing a line of pattern-shop machinery of various sizes, but without the use of a foundry of its own. Improvements are continually being made in the machines and these require many changes in the patterns.

The objects of the system are: First, to give each machine a number and the different parts on it another number, which in combination with the machine number forms the piece and pattern number, and to give similar parts of different machines a similar number. Second, to easily find out what castings have been ordered and how many of them have been received. Third, to know the location of each pattern, whether at the foundry, in the pattern shop, or in storage. Fourth, to record all changes in patterns. Fifth, to provide the foundry with an efficient method of properly filling their orders.

Foundry_____

Date_____ Order No._____

No. Wanted_____ Patt. No._____

Date	Made	Lost

This card properly filled out must be returned with castings to insure proper credit for same.

FIG. 2. CARD SENT TO PATTERNMAKER

Foundry_____

Date_____ Order No._____

No. Wanted_____ Patt. No._____

Date	Received	Total Weight

FIG. 3. CARD SENT TO CASTING ROOM

4-18-1908 Mat. Gray Iron Patt. No. 24-1

Name Bed 12"

Weight		No. Parts	13 Loose Pcs.	Patt. Mat.
Rough 319#	Pattern	1	4	Wood
Fin. 278#	Core Box	2	3	Wood

			Where Used	
			No.	Machine
Out	4-19-08	Ideal Foundry		
In	4-26-08	O. K.		
Out			1	12"-No. 24 Lathe
In				
Out				
In				
Out				
In				
Out				
In				
Out				
In				
Out				
In				
Out				

FIG. 1. CARD FOR INDEX

Naturally the system starts in the drafting room which, after designing a new machine, prepares a complete list of the parts on the said machine. This is then divided into three lists, a casting list, a steel list, and a bolt and screw list. The casting list is the only one which interests us here, the steel and screw lists being distributed to the foremen and to the cost department. These lists are typewritten on letter-size paper with a black ribbon and a black carbon paper with the carbon side against the back of the sheet, thus giving a list which may be blue-printed, and hence can be made very cheaply. The blue printed list like any blueprint will stand plenty of handling in the shop before it is too dirty to be read. The casting list shows the pattern number, the name of the piece, the material, the number required for one machine and the drawing number.

In explanation of the first object, let us take a certain type of lathe made in four sizes, say 12, 16, 20 and 24 inches and known as No. 24 lathe. There are several parts which are used on all sizes and these are given numbers above 400, for

PATT. NO._____ DATE_____

PATTERN CHANGE CARD

Pattern Shop will change above pattern per drawing No._____

Sign and return card to drafting room.

Changed_____ Foreman

FIG. 4. CARD FOR ORDERING PATTERN CHANGES

instance a certain sleeve is No. 24-423. All parts used only on the 12-inch are given numbers below 100, those on the 16-inch, 100 to 200 and so on. The bed for the 12-inch is 24-1, for the 16-inch, 24-101, for the 20-inch, 24-201, and for the 24-inch, 24-301, and similarly for each part like the leg, the headstock, etc. The bed on all lathes of other types is numbered 1 or 101 and so on according to the number of different sizes made.

When the pattern is made, a card like Fig. 1, is made out and put in its place in the index case. The weight spaces are filled out later from the records of the casting-room foreman. The patterns are stored on shelves, divided into sections, which are plainly marked with the machine number.

To fill a production order for a number of 24-inch surfacers, the order clerk takes the casting list for that machine and makes out cards like Fig. 2, which are sent to the pattern shop. A duplicate like Fig. 3 goes to the casting room so the receiver will know what castings are coming and can check them off until the order is filled.

Upon receipt of the casting order, Fig. 2, the patternmaker consults his change index to see if any of the patterns from which castings are ordered, have been ordered changed and are still unfinished. If the pattern is ready and the card shows it to be in the storage, he obtains it, and fastens the order to it so it can be taken to the foundry. If the card shows it to be at the foundry, the card is sent there and on receiving it they know the molder has the patterns. When the pattern goes to the foundry the date and the foundry name are entered as shown in Fig. 1, and when it is returned the date is entered after the word, IN. In the space after the date the condition of the pattern is noted, or the loss of any parts is recorded.

The card shows at all times where the pattern is, and if in storage, its condition, and as the castings are ordered in large lots, the care of the card is nominal. On the back of the card is a space for entering the changes and the date of same.

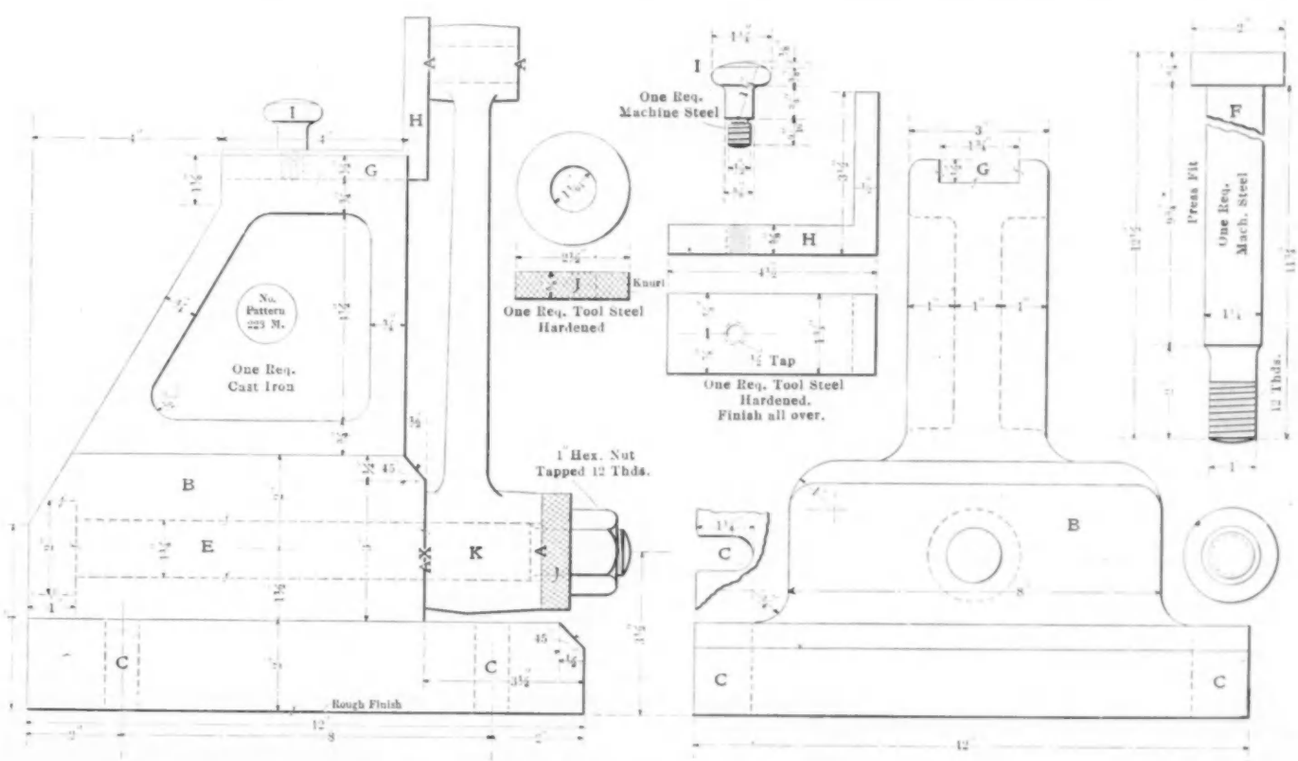
Fig. 4 shows a pattern-change card which is self-explanatory.

Fixture for Straightening Connecting Rods

BY REUBEN B. LOVEJOY

The connecting rods for which this fixture was made were drop forged steel. We were very particular about the faces of the bosses at *A*, being parallel to each other and the holes *K* being at right angles to the faces. The fixture shown in the cut was designed for the purpose of ascertaining whether the faces were parallel or not and also for holding the rods while they were being straightened.

The casting *B* is made quite heavy and strong and is bolted to a bench with 4 lag screws at *C*. The face *AX* of the



ASSEMBLE AND DETAILS OF FIXTURES FOR STRAIGHTENING CONNECTION RODS

casting is finished, the hole *E* bored and the pin *F* driven into it. The slot at *G* is planed in very carefully at right angles to the face *A X*.

The square *H* is hardened tool steel and has a button *I* for lifting or sliding it in the slot *G*. The width of the square is made equal to the diameter of the boss on the connecting rod.

The face *A X* of the connecting rod is finished off as the first operation on the piece. It is then bolted squarely on the fixture, against the face *A X*, by the pin *F*, the washer *J* and the nut as shown. The square *H* is then slid up to the face of the boss on the small end of the connecting rod. If the boss is not true with the one on the other end, it is straightened right on the fixture and is tested by the square until it is true. After truing up these bosses the machining may go on, starting from the already finished face of the rod, and you can depend upon the faces all coming parallel with each other and the holes can be drilled at right angles to the faces and in line with each other.

By having the square the full width of the boss as mentioned before, it is readily seen whether the boss is in line both ways or not by sighting across.

This fixture, if made right, is a great help to the accurate machining of connecting rods.

Molding a Draw-bridge Center Casting at a Small Cost

By John Gregson, Jr.

In these days of molding machines, match boards and pattern shops fitted with various mechanical devices, it is hard for the young men, especially those of us who have learned our trade in a steel foundry, to realize some of the makeshifts and short cuts used 30 and 40 years ago.

The old-timers tell us of going to work with a few strips of wood, a sweep or two, and a straight-edge, to construct a complicated bed plate with a rough sketch as a guide; how the cope would be staked and rammed on a level bed, and the whole operation of sweeping on and cutting out explained and commented upon.

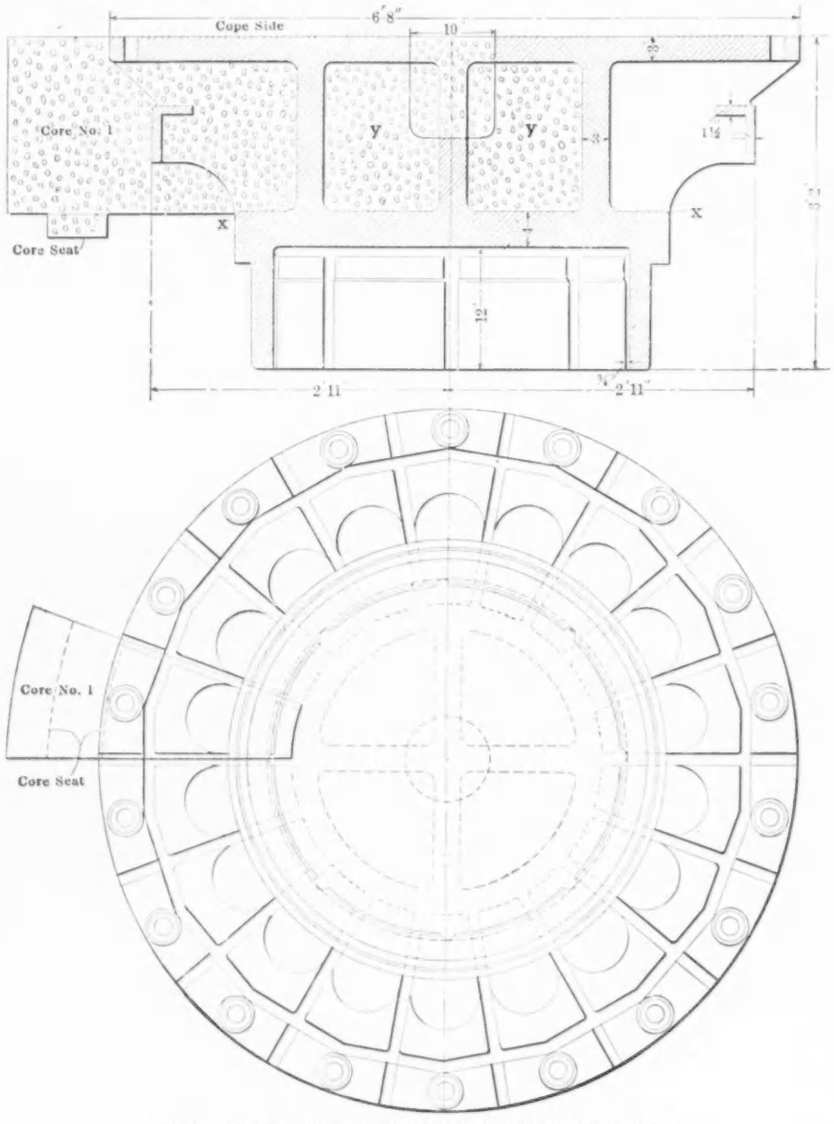
Then we go out and watch piece workers putting up wheel centers from match boards in machine-joined flasks, so that any cope will fit any drag, or see mold after mold turned out of the machines, each perfectly and exactly like the other, and we think perhaps there is as much ingenuity to be shown in the trade now as formerly, but of a different kind.

All of our work, however, is not of such a set type, though our shops run to specialties, and once in a while one comes across something that requires more than ramming up and rolling over. The problem presented by this intricate draw-bridge center was fully as much one of economy as of molding. There was only one casting to make, and that would probably never be duplicated, so we wished to have the pattern cost as little as possible and at the same time to construct it in such a way that the molding cost would not run away with the job.

The pattern consisted of a cylinder which formed the mold up to the point *X*, leaving its own core; a ring held by cross-arms, doweled to the cylinder, to form the seat for the cores which surrounded the mold, as shown by core No. 1; a sweep to give the thickness of the center plate, and core boxes for core No. 1, center core *Y* and the tool clearance and oil-groove cores.

The cylinder and core seat were rammed up and the parting made with a straight joint at *X*. The main core was vented well with a cinder bed to carry the gases off on all four sides. A plain 12-inch cope, with four 16-inch risers, was rammed on the drag section thus made, and a 4-inch hole was left in the center to tie up core *Y* and to take off its vent. The gate was in a corner of the flask outside the print line, so as to bring the metal into the very bottom of the mold with a swirling motion to avoid cutting the main core. The cope was then lifted off, the print of the core seat drawn, the thickness of the center plate (4 inches), plus the thickness of the clearance cores, was swept out, and the cylinder drawn. The tool clearance and oil-groove cores were then put in the green mold, and after dressing and washing it, the cope and drag were put in the oven and thoroughly dried.

The next operation was the setting of the 19 cores that formed the cheek part of the mold. The No. 1 cores, 18 in number, were placed in position on the drag, and, guided by the core seat, a frame was put on and heap sand rammed securely around the assembled cores. The vent from these cores came off at the back and was carried away through the cope joint. The gate was carried through the cheek, mating up with the drag gate. The center core *Y* was then set in on anchors of the right hight. The top of this core came level with the tops of the No. 1 cores.



MOLD AND PATTERN FOR MAKING DRAW-BRIDGE CENTER

The last step was the placing of the cope. As already stated, it was perfectly plain, so that no guides were needed other than those given by the gate, which had to mate up with that in the cheek, and the hole for tieing the core *Y*. The risers and runner were built up 24 inches and the mold braced and weighted. The pouring was very satisfactory and the casting, which shipped at 16,125 pounds, was perfect.

The pattern cost could, doubtless, have been made much lower, as, for instance, by using sweeps for the cylinder part, but the molding cost would have been so high as to more than offset that saving. The pattern could have been more expensive, even solid, with prints for all the cores, but it is a question if the molding cost would have been appreciably less. The appearance of the casting could not have been improved in any case.

The way the job was made seems to give the best possible results with the least possible expense, which is the point sought. At the same time it called for a showing of no little mechanical skill and ingenuity on the part of both pattern-maker and molders, and that of a kind not seen so often now as in the earlier days.

The report of the Bureau of Navigation of the Department of Commerce and Labor shows that during the month of April there were constructed in the United States 114 steam and sailing vessels, aggregating 63,176 gross tons. Eight of these vessels, of which five were built on the Great Lakes, account for 46,152 tons, or 73 per cent. of the total. The five were built on the Great Lakes, including the three largest, while two were built on the Delaware river, and one at San Francisco. In the total list the steel steamers account for sixteen vessels of 52,217 gross tons, or an average of 3264. For May the figures were 116 vessels and 51,401 tons, of which ten steel steamers accounted for 43,952 tons.

Determining the Critical Points of Steel

By J. C. Miller

It has long been an established fact that before a high-carbon steel should be heat-treated, the point at which its carbon changes from hardening carbon to the cement form should be accurately determined.

This point found for one steel will not do for another unless its analysis is the same and to buy steel of constant carbon content is difficult, as is also the determination of this carbon content in the absence of a laboratory.

To any concern which has an electric-lighting current at its command, the critical points of any steel may be simply and accurately fixed in the manner described below by one who may not be an expert.

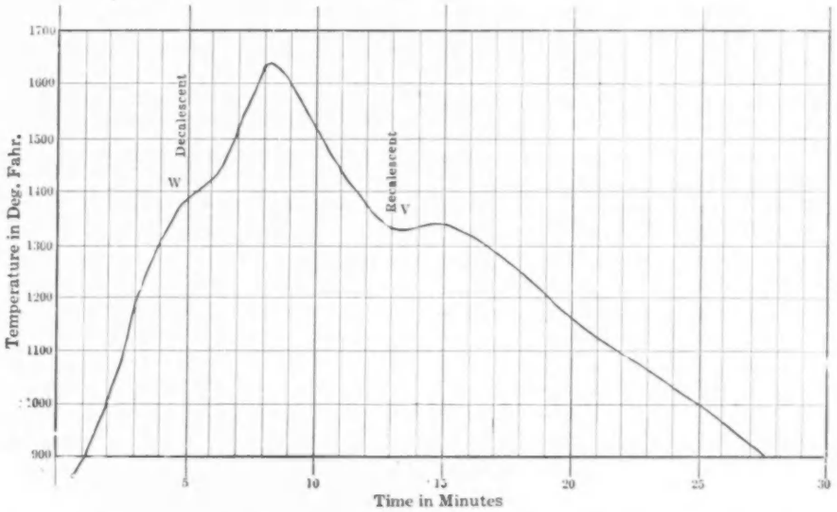


FIG. 1. HEATING AND COOLING CURVE OF STEEL; SHOWING THE CRITICAL POINTS

The importance of this determination may be understood from the following established facts: When carbon steel is being heated a point occurs, as shown by the alteration in the heating curve at *W*, Fig. 1, which has received various names by writers, but which is called the decalescent point by Webster. This point is the one where there is a slight decrease in the continuous rise in temperature, as shown by a heat gage or pyrometer, although heat is being added continuously and uniformly.

When a highly heated steel is being uniformly cooled a similar point occurs in the cooling curve as shown at *V*, Fig. 1, which is called the recalescent point. This point is more worked than the point *W* and is usually about 54 degrees below it. A noticeable rise in temperature occurs at this point which is readily detected. About these points, *W* and *V*, hinges the successful heat-treatment of steel, a rise of 50 degrees above the proper point making a decided difference in the work of a tool.

The finest fracture and best results when hardening are attained by quenching from a point 50 degrees above the point *W*. The best results in annealing are attained by heating to a point between *V* and *W*. Every degree of heat added above *V* detracts from the lasting qualities and increases the coarseness of the fracture. The sum of all these conclusions, therefore, is to find these points, and they are lowest in the highest carbon steels.

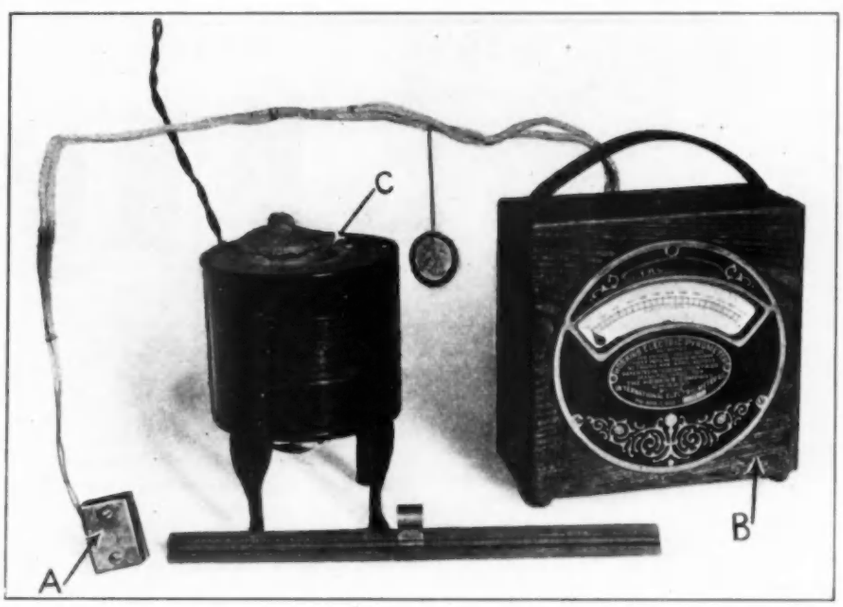


FIG. 2. APPARATUS FOR OBTAINING CRITICAL POINT

The apparatus and method which the writer uses and which he recommends because of its simplicity is as follows: Take two pieces of the steel, to be investigated, which are about two inches by one inch and one-fourth inch thick; drill and tap these for machine screws so

that they may be clamped together upon the hot end of a thermo-electric couple, as shown at *A* in Fig. 2. This couple should be of small wire so that it has a small mass and responds readily to any change in the temperature. The hot end should also be flattened slightly so that good contact may be had for the transmission of heat. The voltage of the current generated by the heating of the hot end is read direct by the meter of the pyrometer, as indicated in degrees as well as in volts, as shown by *B* in Fig. 2.

Heating is accomplished in the muffle of a small electric furnace on the incandescent lighting circuit, as shown at *C*. This is raised before starting operations to about 1800 degrees Fahrenheit. The whole apparatus is so simple and compact that the operation may be conducted in any room without dust and dirt, or noticeable heat.

I have found the best method of manipulation to be as follows: Have the steel specimens clamped on the couple and the furnace at about 1800 degrees Fahrenheit; place the steel in the muffle of the furnace and note the rise in temperature indicated by the pyrometer. A decided lag will be noticed in the speed of the indicating needle at about 1385 degrees, or the point *W*, Fig. 1. Note should be made of this lag and the temperature allowed to rise to 1650 degrees Fahrenheit, or thereabouts.

The steel should then be lifted from the furnace, rested upon the top, and allowed to cool in the air. This gives a speed of cooling which allows the operator to detect the point *U* with accuracy and also note the slight rise in temperature. Repeated tests should be made upon the same specimen so that the point will be fixed with absolute accuracy. No question can then arise as to the hardening and annealing points and all operations on that steel will cluster about the points *U* and *W*.

In steel handling as well as in other lines of industry the age of guessing has gone by, accurate knowledge only being the basis of quality.

Special Chuck for Boring Ball Cranks

By A. B. Sowden

The acompanying illustrations show a special chuck which I made for the Smith & Mills Shaper Company, in Cincinnati, Ohio. They almost explain themselves as the ball cranks are finished complete, bored and faced on both sides, and then the small ball is bored for the handle.

It is a great time saver and, as the work revolves you can see that the hole will be in the center of the ball, as it is in plain view as the operations proceed.

This chuck has given good results and others could use it to good advantage.

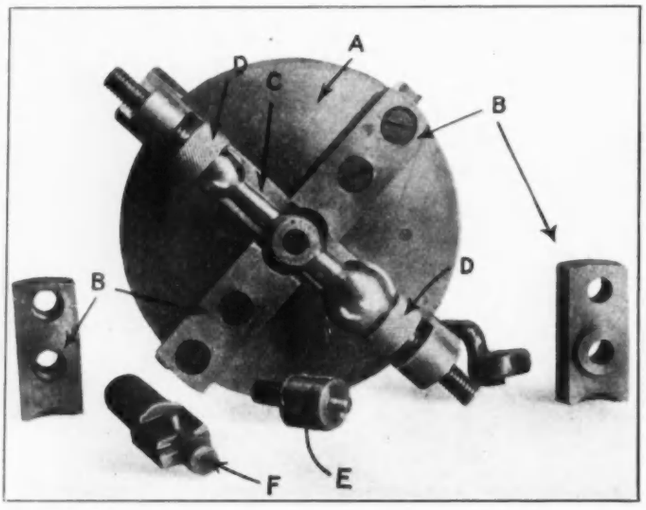


FIG. 1. DETAILS OF THE CHUCK

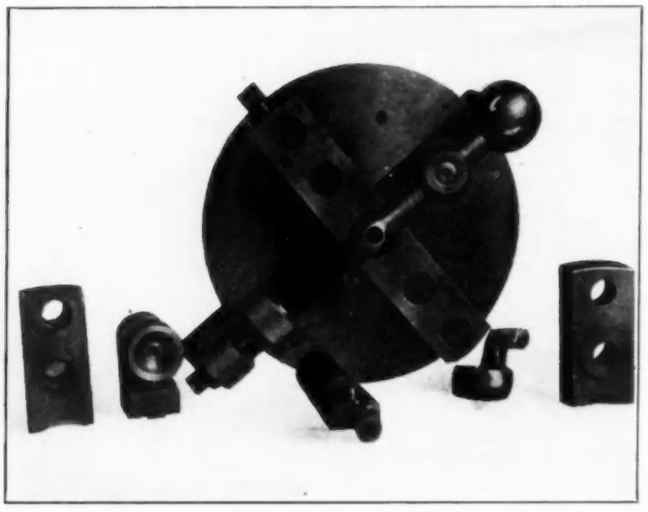


FIG. 2. BORING THE END HOLE FOR HANDLE

Details of Chuck

A is of solid cast iron with two steel jaws with right- and left-hand threads a dove-tail slot running at right angles with the jaws. *B' B* are two pairs of cast-iron jaws; one bored for the center ball and the other for the small ball, and have a lug on the back to fit in the steel jaw so there is no pressure on the screw that holds them. *C* is a piece of steel dovetailed to slide in the chuck and on which is fastened two lugs to hold cup centers *D D*, which line up the crank handle.

E is a plug to screw in dove-tail strip *C* when one of the lugs carrying cup center is removed, and the other end is turned to fit the ball crank, while the holder serves as a stop, so the ball is always a stated distance from the chuck, as in Fig. 2. *F* is the facer with a high-speed steel blade and the pilot is hardened and ground to fit the hole and is used to line up the ball for facing the other side.

Personals *

John R. Morgan, until recently mechanical engineer with the Morgan Engineering Company, has been appointed general manager of the Calumet Engineering Works, at Harvey, Ill.

H. L. Mills, formerly in the sales department of the Whiting Foundry Equipment Company, has resigned to accept the presidency of the American Specialty Company, 1440 Monadnock building, Chicago, which is marketing the "Use-Em-Up" drill socket.

Walter S. Lang, who has spent considerable time in this country studying American machine-shop methods as practiced in a number of the leading machine tool-building shops, sails for Europe September 8, where he will resume his duties in the Glasgow branch of Charles Churchill & Co., Limited.

Obituary

Daniel Haughey, an old-time figure in the machine-shop life of the Pittsburg district, died in that city at the age of 74. Mr. Haughey had the record of 50 years in the employ of one shop, James Rees & Son, and had the distinction of having helped build the first steam fire engine used in Pittsburg.

Trade Catalogs

Joseph Dixon Crucible Company, Jersey City N. J. Pamphlet describing flake graphite.

Keuffel & Esser Company, New York City. Pamphlet illustrating and describing measuring tapes.

Gardner Machine Company, Beloit, Wis. Catalog of "Gardner's Improved" disk

*Items for this column are solicited.

grinders and disk grinder supplies. Illustrated, 9x12 inches, paper.

Chicago Pneumatic Tool Company, Fisher Building, Chicago, Ill. Advance Sheets Catalog No. 26 on Franklin air compressors. Illustrated, 28 pages, 6x9 inches.

American Machine Company, Newark, Del. Catalog describing Denney improved Rider and Ericsson hot-air pumping engines. Illustrated, 32 pages, 4½x7 inches, paper.

H. W. Caldwell & Son Company, Chicago, Ill. Pamphlet entitled "Something Better," which shows machinery furnished the Hecker-Jones-Jewell mill. Illustrated, 32 pages, 6x9 inches, paper.

Rockwell Furnace Company, 26 Cortlandt street, New York. Catalog of portable heaters. Illustrated, 8 pages, 9x12 inches, paper. Catalog of melting furnaces. Illustrated, 32 pages, 9x12 inches, paper.

Business Opportunities

The Buckeye Engine Company, Salem, Ohio, is erecting an addition to its plant.

The Eriez Stove Company, Erie, Penn., is building an $8000 addition to its plant.

The factory of the National Metal Molding Company at Economy, Penn., will be enlarged.

The plant of the Hideite Leather Company, Brockton, Mass., recently burned, will be rebuilt.

The Johnson Chain Company, Morristown, Tenn., will erect building and install machinery.

The Terry Steam Turbine Company, Hartford, Conn., has completed plans for a new factory.

The Salina (Kan.) Foundry and Manufacturing Company will erect a new two-story building.

E. H. Holliday, of Knoxville, Tenn., contemplates establishing a stove foundry in Houston, Tex.

It is reported that the Pullman Company, Chicago, Ill., will rebuild its shops on a larger scale.

The Bonita (La.) Cotton Gin Company has commenced erection of cotton gin, which will cost $12,000.

The plant of the Baltimore (Md.) Fire Brick and Retort Company, recently burned, will be rebuilt.

The Richmond Oil Company, of Chattanooga, Tenn., will erect a cotton gin at Huntsville, Ala.

The Laconia (N. H.) Car Company will make improvements at its plant, including a new cabinet shop.

The Susquehanna Iron Company, York, Penn., will rebuild rolling mill recently wrecked by explosion.

The W. D. Forbes Company, New London, Conn., building engines and motors, is erecting a new plant.

J. H. Ball, Bridgewater, Mass., is said to be planning the erection of a factory for making electrical supplies.

The Newton Haggerty Ladder Company, of Detroit, Mich., will move to Ann Arbor, where a new plant will be erected.

The Pacific Malleable Castings Company, Riverside, Cal., will commence the erection of a foundry to cost $25,000.

The Mullins Rotary Pump Company, Los Angeles, Cal., is preparing to erect a plant. Offices are in the Mason building.

It is reported that the Standard Scale Company, Rome, Ga., will put up an addition for the manufacture of pipe valves.

The J. J. Newman Lumber Company, Hattiesburg, Miss., whose sawmill was destroyed by fire some time ago, is rebuilding same.

The machine shop of C. C. Force & Son, Madison, N. J., which was burned last January, will be replaced by a new and uptodate structure.

The E. J. Jones Company, Buffalo, N. Y., makers of steel balls, etc., whose plant was partially destroyed by fire, will rebuild on a larger scale.

The Boston & Albany Railroad, it is stated, will erect a roundhouse at West Springfield, Mass., to cost $125,000. W. Shepard, Boston, chief engineer.

A $250,000 plant for the manufacture of bridge and construction steel will be built at Memphis, Tenn., by the Virginia Bridge and Iron Company, of Roanoke, Va.

The Pittsburg-Hixon Company, which has a large steel specialty plant at Butler, Penn., is to issue $150,000 bonds for enlarging the plant and making other changes.

The Board of Trade of Massillon, Ohio, has negotiated with A. B. Clark, of Canton, Ohio, for the establishment of a rolling mill for the manufacture of steel sheets.

The Warner Arc Lamp Company, Muncie, Ind., will establish a plant in Houston, Texas. Machinery costing $20,000 will be installed, which will have independent motor drive.

The Crescent Gin and Fertilizer Company, Tuscaloosa, Ala., has been organized to build a cotton gin and manufacture fertilizers. A. E. Bell, R. K. Bell and others, organizers.

The Georgia & Florida Southern Railway, it is reported, contemplates the expenditure of about $200,000 for the erection of shops. E. L. Bemis, vice-president, Douglas, Ga., should be addressed.

The Hammond (Ind.) Machine and Forge Works Company, has been incorporated and will erect and equip a factory and forge plant. Directors, C. H. Luthman, Peter Moser, Daniel Bruhn.

The Baltimore (Md.) Metal Stamping and Manufacturing Company, recently incorporated, will erect building and install machinery for manufacturing metal ceilings, etc. Meyer & Moran, Baltimore, are engineers in charge.

Plans are being prepared by M. P. Paret, chief engineer, United States and Mexican Trust Building, Kansas City, Mo., for roundhouse, blacksmith and erecting shop, power house, etc., for the Kansas City, Mexico and Orient Railway Company.

A company has been organized in Sanford, Fla., to build a railroad from Sanford to Lake Okeechobee, to be known as the Sanford & Everglades railroad. Capital, $50,000. Incorporators, A. T. Rossiter, S. O. Chase and others. Headquarters will be at Sanford.

The Connellsville Iron Works, New Haven, Penn., builders of boilers, tanks, coal-mine equipment, etc., is erecting an addition, and will be in the market for additional machinery, including rotary shear, universal shear, angle bender and air-compressing plant. It is reported that later on another building will be erected to be used as a machine shop.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids on the following dates: Sept. 8—twist drills (schedule 265), files, belt lacing (schedule 263), pulleys, tap holders, valves (schedule 266), electrical supplies (schedules 259, 261, 265). Sept. 15—pattern makers' lathes (schedule 273), electric motors (schedule 290), bolts and nuts, taps, machinists' vises (schedule 293), files (schedule 278, steel (schedule 277), valves (schedules 294, 296). Sept. 22—brass cotters, miscellaneous drills (schedule 256), drilling machines (schedule 287).

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E. G. Smith Co., Columbia, Pa.

Small, accurate drill jigs and dies built to order. R. Rosner, Madison, Wis.

Steel case hardened; modern methods. Boston Gear Works, Norfolk Downs, Mass.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Wanted—Orders for brass goods. Castings and finished product. Box 411, AMER. MACH.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Machines designed; automatic, special. Practical working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Special machinery accurately built. Screw machine and turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Tools—Send your name and address on postal for our net priced catalog. Every machinist should have it. Montgomery & Co., 105 Fulton St., New York City.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Lathe and machine work of every description, patterns, gear cutting, screw machine work, iron, brass and aluminum castings. The Sipp Electric and Machine Co., Paterson, N. J.

Tomey's Scotch gauge glasses, made at Tay Glass Works, Perth, Scotland, are sold by Montgomery & Co., 105 Fulton St., New York City. Beware of imitations, and don't take the "just as good as—."

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Machinery built to order and by contract; special parts made; gear cutting, automobile and pattern work, punch press and screw machine work, tools, dies, etc. Blair Tool and Machine Works, West and Morris streets, New York City.

Wanted—First-class machine shop in the most rapidly growing city on the Pacific coast: Eugene, home of the State University and hub of the famous Willamette Valley. Address Department M B, Commercial Club, Eugene, Oregon.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

MASSACHUSETTS

Draftsman and designer, practical mechanic, technical education, wide experience. Box 414, AMERICAN MACHINIST.

Position as shop manager by practical mechanical engineer with excellent experience and references. Can buy interest in good prospect. Box 393, AMERICAN MACHINIST.

Position by an American as superintendent or assistant superintendent. Practical man with drafting-room experience. Executive ability. Reference. Box 386, AMER. MACH.

MINNESOTA

A good mechanical draftsman with technical education desires a permanent position with chance to advance. Am familiar with machine shop and foundry practice, one year's drafting room experience and three years' operating steam and gasolene engines. At present employed. Age 24. Box 425, AMERICAN MACH.

MISSOURI

Position Wanted—Chief draftsman, with 10 years' experience in electrical and mechanical lines, desires change. Has held present position over three years. Executive position preferred. Will go anywhere. Box 423, AMERICAN MACHINIST.

NEW JERSEY

Practical man, age 30, shop and drawing room experience, last six years superintendent's assistant, desires responsible position. Reference. Box 428, AMERICAN MACHINIST.

NEW YORK

Superintendent, good mechanic, live man, desires change. Box 430, AMER. MACHINIST.

Machine designer, draftsman and general all-round machinist, with inventive ability and a hustler, 20 years' experience, wishes position. Box 417, AMERICAN MACHINIST.

Mechanical engineer is open for engagement as superintendent, master-mechanic or general foreman. Technical education and large experience in the designing and construction of small interchangeable machinery, special tools and labor-saving devices. "G. W. N.," 732 Marcy Ave., Brooklyn, N. Y.

OHIO

Position with engineering firm. Have been a successful designer and erector and have experience in pattern work. Foundry work and machine shop outside work preferred. Box 426, AMERICAN MACHINIST.

PENNSYLVANIA

Expert cost accountant and systematizer desires an executive connection with manufacturing concern. Up-to-date methods and satisfactory results guaranteed. Box 304, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

ILLINOIS

Wanted—A man capable of drawing new alloy wire, using diamond dies. State salary expected and experience. Box 402, AM. MACH.

Wanted—Patternmaker and draftsman. Experienced in gasolene engines. One that has progressive ideas. Full particulars in first letter. Box 424, AMERICAN MACHINIST.

Wanted—Designing draftsmen. Thoroughly experienced on water-wheel work. Desirable positions open immediately for satisfactory men. Apply giving experience in full and earliest date of reporting for duty. Box 403, AMER. MACH.

MASSACHUSETTS

Draftsman wanted with experience at machine work. Address, stating age, experience and pay required. Golding Mfg. Co., Franklin, Mass.

Wanted—Storekeeper for machine shop. Must have had similar experience and be familiar with shop supplies. Good chance for energetic young man who is systematic and quick. Box 421, AMERICAN MACHINIST.

MICHIGAN

A thoroughly competent operator on Acme automatic screw machines. A permanent position to the right man. Factory located Detroit, Michigan. None but a steady thoroughly competent man need apply. Box 422, AMER. MACH.

NEW JERSEY

Chief engineer for a well established machinery manufacturing plant having a wide variety of custom work. Only those who state past experience, references, age and salary expected, will be considered. Box 420, AMER. MACH.

NEW YORK

Wanted—First-class die sinkers of drop-forging dies. Address "A B C," AMER. MACH.

Wanted—Young man to sell a special machine tool in New York territory. Must be willing to start on commission and small salary. Box 419, AMERICAN MACHINIST.

Wanted—By a firm in the vicinity of New York City, building marine gasolene engines, first-class draftsman for gasolene engine work. American preferred. Apply "Gas Engines," Box 429, AMERICAN MACHINIST.

Wanted—Mechanical engineer to supervise work of drawing office and tool department in metal working plant employing over 1000 hands. Must have had practical experience in designing and constructing special equipment used in making small interchangeable mechanisms. Executive ability and good judgment in handling men a requisite. Man familiar with master plate methods used in the manufacture of watches, clocks, guns, typewriters and sewing machines preferred. State experience in detail, give age, salary expected and references. Box 413, AMERICAN MACHINIST.

PENNSYLVANIA

Wanted—Toolmakers, strictly high grade on dies, jigs and gauges for fine interchangeable work. Address the Elliott-Fisher Co., Harrisburg, Penn.

Wanted—Model maker, first-class man on fine model work and brass patterns. Address the Elliott-Fisher Co., Harrisburg, Penn.

Wanted—Tool inspector. A fine chance for a bright up-to-date toolmaker on tool and gauge, tap and die inspection. Address the Elliott-Fisher Co., Harrisburg, Penn.

Wanted—By a corporation commencing the manufacture of wrenches, a man thoroughly versed in organizing, finishing and assembling of monkey wrenches and pipe wrenches. Must be a practical machinist and thoroughly versed in shop work. State former positions; references and salary. Box 427, AMERICAN MACH.

Wanted—Young man familiar with the erection and testing of high-speed automatic engines. One who has had some outside erecting experience preferred. To receive consideration give full details of experience, employer's name, duration and compensation last two engagements. Box 407, AMERICAN MACHINIST.

WISCONSIN

Wanted—For a high grade manufacturing concern, a man who is a thorough mechanic, who thoroughly understands assembling and machine work, to take position of inspector. Must be a man of force and at the same time a man who has a faculty of getting along with those with whom he comes in contact. State past experience, with whom, age, etc. Factory is equipped with best machinery and tools and normally employs about 600 men. Box 406, AMERICAN MACHINIST.

For Sale

For Sale or Rent—Foundry, machine and wood shops with machinery in town of 5000. Box 227, Bergen, N. Y.

For Sale—Foundry and machine shop, well equipped and successfully running under lease, at Baker City, Oregon. A great bargain for cash. Address A. J. Schumacher, 160 S. W. Temple St., Salt Lake City, Utah.

For Sale—Tracings, patterns, jigs and templets for the following size gas and gasolene engines: 1½, 3 and 5 horse-power vertical and 3, 5, 8, 10, 12, 16 and 20 horse-power horizontal; also a number of finished and unfinished engines of the above sizes. All of the above sizes have been in successful operation for several years. This is a splendid opportunity for anyone wishing to build gas or gasolene engines. You can save thousands of dollars in experimental work by purchasing this complete outfit. Shop rights of valuable patents on these engines will be given to purchaser. Box 366, AMERICAN MACHINIST.

A successful machine shop for sale manufacturing a special machine that has the largest sale of its kind in the world. The owner having acquired a competency from the business in the last 10 years wishes to retire from active business and will sell at a fair price on condition the business will continue at the present location. Would accept payment in machines at a certain per cent. over cost and will continue in charge until the amount of the purchased price is received in machines. Parties wishing to communicate with me must do so direct and be prepared to furnish a $75,000 bond in case of sale. Address "Machine Shop," Glenarm, Md.

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